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PROPOSED NEW FREQUENCY.

The paper presented last week before the American Institute of Electrical Engineers by Messrs. L. B. Stillwell and H. St. C. Putnam is very instructive through the analysis which it gives of the estimated cost of operating electric locomotives and steam locomotives on main trunk railroads. The conclusions drawn are decidedly in favor of the electric locomotive under certain conditions. The discussion of the paper presented marked differences of opinion, except as to the question of frequency. Some favored the direct-current locomotive, others the alternating-current locomotive. The paper favored the latter and pointed out the advantage of a new 15-cycle-per-second frequency, as an aid to electric locomotive design. Much of the discussion turned on the question of introducing such a new standard frequency. The proposition is one of considerable importance to other electric interests. If electricity comes into operation on our trunk railroads for the propulsion of all traffic we are likely to have various large scale interference phenomena. Neighboring telegraphs, telephones and even transmission lines are likely to be affected inductively, to some extent, by the powerful currents that would be carried along the railroad rights of way. The telegraphs are sure to be bothered; but, on the other hand, they are also sure of finding some *modus vivendi*. The telephonic trouble might be so serious as to require all telephone lines to quit and avoid railroad routes. It is to be hoped that the low frequency chosen may be inaudible; but even if itself inaudible its harmonics are sure to be audible, and also the commutation frequency notes, when the motors are in action. The lighting and power interests of the country are also interested in this question. A new frequency is very easily established by a manufacturing company. Its engineers naturally study the particular and relatively small railroad problem that first presents itself, and work out the best and most economical frequency for that particular installation. Once, however, the new frequency has been successfully used in a single installation, it becomes an argument for the retention of that frequency in another case. After a few years of unchallenged natural growth it becomes too late to change the new frequency, because too much capital has been invested in its use, and extensions require uniformity of operation, particularly in the case of electric railroads.

Looking back we can now see how unfortunate a choice was arrived at in adopting the frequencies of 60 and 25 cycles per second, respectively. A better combination would have been 50 and 25, or else 60 and 30. Frequency changers would have been rendered easier to construct and to operate, if the two frequencies in general use bore a two-to-one relation. The new frequency selected is sure to increase the difficulties in connecting power transmission systems and power plants together. It may be a necessity to employ a lower frequency than 25 cycles per second in alternating-current railroad operation, and it may be granted for the sake of argument that the new required fre-

quency is in the neighborhood of 15 cycles per second. The question arises, however, whether in the course of a few decades the choice of just 15 is likely to prove advantageous. If the standard frequencies of to-day were 60 and 30 there can be little doubt but that 15 would be better than any other number in that neighborhood. But on the other hand, if we had 50 and 25 the new frequency would logically be 12.5. It seems to be a matter for discussion whether under existing circumstances the new frequency should be 15 or 12.5. The difference is by no means negligible, since it amounts to 16⅔ per cent of the greater number and to 20 per cent of the lesser. A reduction from 15 to 12.5 for the sake of simpler frequency changers in the greater number of expected transformations of power might work undue hardship to the prospective electric railway business by adding materially to the costs of alternators and transformers. The question, however, is of such prospective future importance to all electric lighting and power interests that we hope the manufacturers will consider the matter carefully before adopting a new frequency permanently. Incidentally, it is to be noted that although incandescent lighting may not be impracticable at a frequency of 15 cycles per second, if incandescent filaments be made sufficiently thick, which means using either low-voltage or large candle-power lamps, yet there is difficulty enough in giving satisfactory and steady illumination at 25 cycles per second; so that a new frequency of 15 cycles per second is likely to be tolerated rather than invited by electric lighting interests.

Engineering Societies Headquarters.

The meeting last week of the American Institute of Electrical Engineers was notable in several respects. It was the first meeting of the Institute to be held in the recently constructed Engineering Societies Building at New York. It was a meeting which completely filled the large auditorium of that fine building, which seats a thousand persons. It was also a meeting which brought together for discussion a larger body of electrical and mechanical engineers than perhaps ever occurred before, the topic of the evening being one which naturall interests a majority of engineers of all denominations. The new building is handsome and commodious. Its illumination is both effective and æsthetic. Although the large auditorium was filled, it would be of but little use to have a larger hall, because although the acoustic properties seemed to be very satisfactory, engineers are seldom trained as public speakers, and it was as much as the audience could do to hear many of the speakers from the more distant seats. It takes either great natural vocal powers, or considerable special elocutionary training, to make a speaker heard by an audience of more than a thousand individuals. It is significant to note that the evident great purpose of Mr. Carnegie in providing the building, has manifested itself even at the very first evening session of the electrical engineers held there. The concourse of many engineers outside of the strictly electrical classification was very noticeable. It might be said that such a mingling might be expected in view of the topic presented—the electrification of steam railroads—and no doubt had the topic been more strictly confined to exclusively electric technology, many of the mechanical railway and transportation men who attended might not have come. On the other hand, however, the fact that the building is to be the joint home of three of the great engineering tribes, and that they feel a joint proprietorship in this building and its halls, makes the mingling of all engineers more probable in the meetings and fosters co-operative action between members of the various tribes.

This tendency of mingling and exchanging ideas, happily fostered at the new headquarters, is also finding reflected stimulus in the recent trend of industrial events. Electrical engineers are daily requiring to be more familiar with civil, mechanical and mining engineering problems and interests. Inversely, civil, mechancal and mining engineers are being called upon to be acquainted more thoroughly with electrical engineering problems and interests. It would seem as though, in the not far distant future, the technical training of mechanical and of electrical engineers would have to become essentially identical. Along with this unification of engineering interests comes the steady development of productive industries along technical and engineering lines. It would seem as though, in times to come, the real executive power of the nation will fall into the hands of the captains of industry. These must either be engineers, or be so closely associated with engineers and engineering, that eventually the conduct of large-scale engineering affairs will spell out the destiny of nations.

Technical Graduates and Central Stations.

Elsewhere we print a very interesting discussion by central station men and professors of electrical engineering, on the article by Prof. George D. Shepardson, entitled "Technical Graduates and Central Stations," which appeared in our first issue of the year. While viewing the subject from widely different standpoints, the opinions of the two classes are identical in that the central station industry can be greatly strengthened by availing itself of the services of the technical graduate, and that the latter will find in this field a profitable career. As Prof. Brooks points out, the percentage of graduates who now yearly pass from the school to manufacturing companies, as contrasted with the relatively small percentage who takes up central station work, does not necessarily imply that there is lack of appreciation of graduates in the latter field. The policy of manufacturing companies is to recruit their technical force from colleges, and it is a vastly simpler matter for a student to find an opening in such companies than in central stations. In the first place, the number of companies to be solicited is few, and very often the advances come from the companies through the college department of electrical engineering. In the second case, the number of central stations is in the thousands and there is no ready means of determining to which application can be made with the best prospects for success. The inclination of the student when considering his future career is naturally toward purely engineering work, but he should realize that positions of this kind are not only small in number as compared with the number of graduates sent forth yearly, but that it is a matter of much doubt if they offer, on the average, a permanent career nearly so favorable as those that may be attained in the administrative and commercial branches of the electrical industry.

In the earlier days of technical education it was feared by many that the great disproportion between the number of electrical engineering graduates and the number of possible professional openings in the industry, would in time lead to a condition when the larger percentage of graduates would experience

the bitter disappointment of having to seek employment in occupations having little or nothing in common with that for which they were educated. Even those taking the most optimisic view have, however, doubtless been astonished at the manner in which the technical college output, notwithstanding its constant increase, has been annually absorbed and, in fact, has not proved sufficiently large to meet the demand of the industry. The reason for this is that it was early learned that the college graduate, owing primarily to his systematic mental training, is excellent raw material for any department of the industry; that owing to the versatility incident to such training he can, after a short apprenticeship in the shops, be drafted with equally good results into any department of a company—engineering, administrative or commercial. This experience of manufacturing companies cannot be too strongly impressed upon central station men who are considering what use they can make of the technical graduate in their plants. They should not look upon the question as one merely of creating in the plant a position for a professional engineer—concerning the advisability of which action many may have strong doubts—but rather of taking on raw material capable of handling in time in a highly satisfactory manner any branch of the business, and yet during the period of probation capable of giving full value in technical and other service.

PRACTICAL PHOTOMETRY.

A recent paper before the British Institution of Electrical Engineers brings to mind the recent excellent work done in England on photometrical matters, and especially calls attention to the lack of a convenient form of portable photometer in this country. Most of the work done here is laboratory work with laboratory instruments. The old Bunsen photometer is the standard form employed for most purposes in this country. In fact, the Bunsen photometer has many virtues and it is particularly easy to use and is cheap and simple of construction. Moreover, it gives, when comparing lights of different colors, better results than many of the most expensive and complicated forms. Yet as commonly used in laboratories, it is a two-eyed affair and the different sensitiveness of the two eyes or their different states of adaptation due to different external conditions on the two sides of the observer, may introduce very serious errors in the results. This liability is especially incurred in using portable apparatus in which the photometer screen may itself be properly sheltered from extraneous light, without, however, any provision for insuring uniform protection to the observer's two eyes. It is entirely possible, as has been well shown in the practice of the Bureau of Standards, to do good photometrical work in a comparatively light room, if the instrument is properly shielded. But an observer's eyes, if used simultaneously in reading the instrument, must be alike protected and must work under conditions far more uniform than generally exists when using a portable photometer.

To judge from Mr. Harrison's paper and every other recent publication in England, a number of forms of portable photometers are there in use, based upon somewhat different principles. The flicker photometer screen appears to be in far more extensive use than in this country, and is particularly well liked for the comparison of lights differing considerably in color. Although recent work indicates that the flicker screen is far from actually eliminating the color difficulty, yet it is regarded, probably with good reason, as tending to diminish it. Modified forms of the Weber photometer using a fixed standard light with a variable diffusing screen, are also in considerable use, and there seems to be far less employment of the cruder forms of apparatus than in this country. Photometrical appliances are uncertain enough at their best. Save within a very limited range of application they can hardly be considered as instruments of precision. It is to be hoped that the growing interest in scientific illumination will lead to the production of much more precise and convenient apparatus than is now available, especially for portable use. It ought not to be difficult to produce portable incandescent standards and means for applying them with far greater ease and accuracy than is possible in any commercial apparatus now upon the market. A field here seems to be open to American instrument makers.

WATER PUMPING BY CENTRAL STATIONS.

The pumping of water for the waterworks system of a small town by the central station company is a class of business which has been undertaken by a number of small central stations. If the contract is obtained at a reasonable rate, the business should prove a most satisfactory source of income, especially where the water system has a standpipe or elevated reservoir of some kind for the storage of water so that it is not necessary to operate the waterworks pumping machinery during the peak of the lighting load. Of course, there are a number of combined waterworks and electric light plants where the pumping is done by steam obtained from a single set of boilers. In the majority of cases the waterworks plant is already built separate from the lighting plant so that it is a problem of installing electrically-driven pumps operated from the electric light station, if the central station company takes over the pumping of water for the waterworks. The apparatus necessary to pump water for a waterworks system by means of electric motors, of course, depends largely on the source of water supply and the presence or absence of auxiliary storage in the shape of a standpipe or elevated tank. Geared or belted plunger pumps driven by motors have heretofore been most commonly employed in this work, but the centrifugal pump is now beginning to enter the field. An interesting application of centrifugal pumps to waterworks pumping is described in an article in this issue on the La Grange, Ill., pumping plant. The plant contains several novel features. One of these is the use of a vertical shaft centrifugal pump 80 ft. below the surface, placed in a drilled well which was enlarged to 15 in. at the top to accommodate a centrifugal pump of small diameter. Another interesting feature is the use of centrifugal pumps which can be operated either in multiple for pumping into the standpipe or in series for giving an increased direct pressure in the mains in times of fire. Centrifugal pumps of the type used at La Grange with vertical shafts, and with the pump proper placed at or below water level in the well have been used in much shallower and larger wells to a considerable extent in pumping for irrigation purposes in California. Their application to a well only 15 in. in diameter is interesting and it will be still more interesting to see in the next few years how much of a part centrifugal pumps of this type will play in deep well pumping.

A great many towns in which the central station companies are most likely to secure the contracts for city water pumping get their water supply from deep drilled wells which are of insufficient diameter to admit even a 13-in. pump. In the case at La Grange, the reaming out of the well to 15 in. was not difficult because the well was in solid rock. The mixture of rock, shale, gravel and loose dirt encountered near the surface in many wells might make the reaming-out process and the pulling up of the old casing near the top of the well considerably more difficult. At La Grange there was no casing near the top of the well. The centrifugal pump certainly offers some important advantages for city water pumping by small central stations, because of the small number of moving parts and the little attention required during operation. In many cases motor-driven pumps must operate for hours at a time in a pump house where there is no attendant and where they are visited only occasionally for an oiling of the bearings and a general inspection. The centrifugal pump works most efficiently when it is not placed far above the water level, or in other words, when there is no lift in its suction. When this fact was appreciated the vertical shaft type of pump was designed so that the pump could be placed in the well at about water level and the motor could be at the surface. If the vertical shaft type in some such form as used at La Grange can be employed to supplant the very troublesome equipments heretofore used in deep well pumping, it will certainly be a great advance. A deep well plunger pump with its plungers located far down in the well is a nuisance to maintain and its repair may mean long interruption in the service from one well. On the other hand, deep well pumping by means of compressed air which is now coming to be very common is inefficient, and is not so simple in maintenance as a centrifugal pump outfit. The scientific design of centrifugal pumps to yield a given output at a given speed against a given head has evidently not been carried to a very high state of perfection in this country, judging from the results obtained in practice, but it is likely to be given more attention in the future because of the increasing number of applications for motor-driven pumps. In any event, however, fairly satisfactory centrifugal pumps can now be obtained even if their performance is not always estimated to the nicety prevailing in calculations on electrical machinery.

Central Station Factors to Strive For.

As central station companies are gradually waking up to the fact that the central station business has not in the past been developed to anywhere near the point that it might be in most cities, greater interest centers around comparative figures on earnings, output, investment and the like, which we may classify under the general head, "central station facts and factors." The Iowa Electrical Association has had a committee on facts and factors for several years, which committee, however, has not met with the success in collecting data that it should in future years. The Association of Edison Illuminating Companies has, of course, for many years compared facts and factors in a more thorough manner than any other organization in the central station field. It is a good thing for the industry when central station managers get to comparing notes in this way, because it shows each manager where improvement is possible in his own property. A comparison of gross earnings per capita of population, which is probably one of the most common comparisons, shows what an enormous difference there is in the development of the central station business in different cities and in different parts of the country. As a general proposition, as shown by the last census report, both gross earnings and investment per capita run highest in the far Western States and lowest in the Southern States, while the North Atlantic and North Central States occupy a medium or average position. However, general averages are not as interesting or instructive as the figures from some of the more progressive companies.

The average gross earnings per capita of population in communities served by central stations the country over will probably at the present time be not much over $2.50, yet there are many companies with gross earnings of $5 to $6 per capita and a few which have climbed up to between $7 and $8 per capita. In some cases these high earnings are due to exceptional conditions such as a large water power which draws manufacturing industries which take power from the central station company. In other cases the local conditions are not radically different from hundreds of other places where the earnings are at or below the average. In the latter the difference is mainly due to the fact that the stations with high gross earnings have been so managed as to capture the greater part of the available business in a town and to cultivate more business. Many of the smaller plants can be operated by transmission lines from larger neighboring towns, while in towns of 4,000 and over with efficient management there are central station companies which more than compare favorably with their big brothers in point of earnings per capita and earnings on investment. When we come to permanent investment per capita of population and percentage of gross earnings to investment, figures vary as widely as they do on per capita earnings. One little company recently described in these columns has gross receipts of 30 per cent of its total investment and an investment per capita of $20. Many companies do not have an investment of over $10 per capita and gross earnings 20 per cent of the permanent investment, and many fall far below even these figures.

Some Fundamentals in Central Station Management.

The paper presented by Mr. H. H. Scott before the Northwestern Electrical Association last week in Chicago, which is printed in abstract elsewhere in this issue, is an excellent condensed summary of the fundamental principles which must be observed in order to secure good financial returns from central station investments. The author evidently belongs to that successful school of central station management which teaches that the building of magnificently expensive power plants and the piling up of monumental fixed charges is at variance with the fundamental principle of fixing the investment at a point at which customers can be served at the lowest cost, fixed charges included. The principal points made in Mr. Scott's paper relate to obtaining the greatest revenue possible from the power plant machinery and distribution system and to keeping down the investment in machinery and distribution system necessary to carry the peak load only. These principles are not at all new and have been stated in various ways many times, but they have been so frequently overlooked by engineers possessed of a

desire to rip out everything that is old and install the newest and most expensive machinery, that it is well that Mr. Scott has reiterated them. No one who has ever figured on the fixed charges on apparatus necessary to carry the November and December peaks only and which is not needed the rest of the year, can fail to appreciate the necessity of keeping the investment for this peak of machinery at the lowest possible point. The question of operating cost hardly enters at all, as it is so completely overshadowed by the fixed charges. If machinery for this kind of load could be installed having half the efficiency and costing half as much as the cheapest now obtainable, it might be policy to use it. There are, of course, some cases where real estate is very valuable and a company cannot afford to give up the space to antiquated apparatus taking up a large amount of floor space in proportion to its capacity for carrying the winter peak only. Outside of large cities, however, this condition is not often found.

The position taken by Mr. Scott that a station should ordinarily keep its older and less economical apparatus for carrying peak loads and install the most economical apparatus obtainable for its new units to carry the 24-hour load, is thoroughly sound. This is the natural course of evolution of any central station. It is often modified by the necessity of changing from one system of distribution to another, or of getting more station capacity on a given amount of real estate; but as the central station industry is settling down to more established practice as to generation of current, this natural course of evolution will probably prevail more and more. Another important principle brought out by Mr. Scott is that of seeking a character of load which will give the maximum gross revenue and the maximum output per kilowatt of station capacity. The character of a station's load is more under its control than is commonly thought. His statement that the greater portion of the business of progressive central station companies is not that which comes naturally to it, but that which is sought by solicitation and an aggressive campaign, is well established by comparing the gross revenue per capita of population served by central station companies which are reaching out for business actively, and companies which take only what drifts in to them. Taken all together, almost any central station manager can profit by taking the time to read Mr. Scott's brief paper, if only for the purpose of emphasizing in the mind fundamental principles which have been heretofore understood but not always acted upon.

ADVERTISING THE IMPRACTICABLE.

We have pointed out that it is easy for a central station company or any other concern for that matter, to waste money by injudicious advertising. Frequently the trouble is that the manager, after having signed up a good-sized contract for advertising, or bulletins, turns over the preparation of advertising copy to one who has little idea of the real merits of the things he is trying to advertise and whose only claim to recognition as an advertisement writer is that he was at some period of his existence connected with a newspaper or publishing house. This lack of insight into the real, essential, practical advantages of the things advertised is painfully evident in all classes of advertising. If the presidents and managers of some of our larger central station enterprises would stop to consider from a common-sense point of view the probable income value of some of the advertisements which are turned loose upon the public by the writers of their advertising copy who are trying to do "fancy stunts," we imagine there would be quite a shaking up in some quarters. The central station advertising man cannot keep too closely in touch with what is actually going on in the operating and commercial departments of his company. It is a constant temptation to him to advertise new applications of electricity without regard to their commercial value to his company or the amount of business possible from such sources in his community. Then again, a bad impression may be created of advertising things which the company is not prepared to supply.

To take a few concrete examples, we have in mind one central station bulletin which for months showed in its "Convenient Appliances" columns a portable wall bracket which, upon inquiry by a customer, could not be found at the company's salesrooms, nor did any of the company's clerks seem to know anything about it, or where it could be obtained. In another case a company for months advertised electric flatirons of a certain make at a certain price. After this had been going on for some time a customer at last drifted into the company's office to buy an electric iron and was asked at first 25 per cent more than the advertised price, thus painfully revealing the fact that the supply department did not know what the company's bulletin was publishing; that the advertisement of the iron in the bulletin was evidently not producing results, and therefore certainly should have been changed. In another case a central station bulletin published a handsome illustrated article on the vacuum carpet cleaning system with electric motor drive, and yet there was nothing in the article to indicate how large or how small the apparatus was made. The impression was created that it would be available for small residences, whereas as a matter of fact, on account of its cost and size, it was only suited to hotels and large buildings. The same thing is true in regard to many articles which have appeared on electric refrigeration in central station publications.

Again, we find in some of our most expensive central station publications a great dearth of practical information on the advantages of both the common and the uncommon applications of electricity which are available to every central station user. If the men preparing the publications were well versed in the practical advantages of these appliances and thoroughly familiar with them by experience, they would not need to pad them out with far-fetched references to electricity and to other matters having nothing to do with electricity. It is a mistake to consider that a possible customer will not be interested in simple concrete statements of the advantages of electrical appliances used in home, office or factory if they are set forth in an attractive way. The average man or woman will spare no time to read glittering generalities. In brief, to get at the root of the matter, those who are soliciting or writing advertising for central stations must be thoroughly familiar with what they are writing about. If they have not had the practical experience themselves, they must talk with those who have until they are thoroughly saturated with the subject in hand. Especially is this true of the home uses of electricity. If central station officers and solicitors are not enterprising enough to use all the more common applications of electricity in their own home, it is useless to expect much progress with customers generally.

Annual Convention of the Electrical Salesmen's Association.

The Electrical Salesmen's Association held its annual meeting in Chicago January 24. The meeting for the transaction of business was called to order at 2 p.m. at the Grand Pacific Hotel, with President Vincent Gray in the chair. Secretary George H. Erich read the minutes of the last meeting and gave the treasurer's report. Mr. E. W. Kearns, chairman of the auditing committee, reported that the treasurer's statement had been found to be correct.

The election of officers was then proceeded with and resulted in the following named gentlemen being elected for the year 1907: Mr. C. A. S. Howlett, president; Mr. Francis Raymond, secretary, and Mr. Arthur Jones, treasurer. A committee on revision of the constitution and by-laws was appointed consisting of Messrs. J. R. Cravath, C. A. S. Howlett and J. Robert Crouse.

A committee on co-operation to consider and further the aims of the Co-operative Electrical Development Association among the salesmen was appointed, consisting of Messrs. J. Robert Crouse, Francis Raymond and J. S. Corby. A general advancement committee was appointed consisting of Messrs. E. W. Kearns, C. A. S. Howlett, F. L. Perry, J. R. Cravath and H. S. Green. The finance committee consists of Messrs. Vincent Gray, Arthur Jones and Thomas G. Grier. The auditing committee consists of Messrs. E. W. Kearns, George H. Erich and C. L. Etheridge.

Mr. J. R. Crouse, representing the Co-operative Electrical Development Association, spoke on the importance of having the interest and aid of the electrical salesmen in furthering the movement to interest central stations in pushing harder for new business. In the evening at 6.30 the members convened again with a number of guests in the Bordeaux room of the Grand Pacific Hotel for dinner. After dinner a very instructive evening was spent in discussion. President Howlett introduced Mr. Thomas G. Grier, who, the chairman said, had been preparing this address for fifteen years, and, therefore, it should be of interest. It certainly proved to be, and Mr. Grier was requested to reduce his remarks to writing later for general circulation to the members who were not fortunate enough to be present.

An interesting discussion was then opened on the relative importance of the house and the salesman in selling goods. This was taken part in by a number of electrical men, Messrs. M. C. Cotabish, George Searing, Fisher, of Boston, and Vincent Gray. A most eloquent address championing the salesmen's side of the question was given by Mr. R. P. Evans, of the Moneyweight Scale Company, who is instructor of the salesmen for that company.

The association starts in the new year with a very efficient, enthusiastic and well-acquainted corps of officers, and should certainly occupy an important place that has as heretofore not been filled by any organization. It is the aim to make this a dignified professional body of electrical salesmen, corresponding to the national engineering professional organizations. Plans are now under way whereby meetings will be held in various cities more frequently than once a year and means are provided whereby some of the best papers and discussions will be printed and circulated among the members so that members will obtain more in return for their annual dues than has been obtained in the past. The constitution and by-laws will be revised and provision will probably be made for the holding of section meetings in various cities. It is not by any means a salesmen's "union," as some manufacturers have seemed to have feared, but has for its object the education and mutual instruction of its members, so that they may become better skilled in their profession as salesmen. The plans now under way, if carried out, will overcome the inherent difficulties under which the association has labored in the past year in not being able to get together for more frequent meetings, and of having insufficient funds to circulate the proceedings of its meetings, even had such meetings been held.

Technical Graduates and Central Stations.

Below we print a number of comments on the very interesting article by Prof. Geo. D. Shepardson, entitled "Technical Graduates and Central Stations," which appeared in the first issue of the year. As expressing the opinions of both central station men and professors of electrical engineering, who naturally view the subject from widely different standpoints, the discussion forms an interesting and valuable contribution to a matter of timely importance.

I entirely agree with most of Prof. Shepardson's arguments and conclusions and my only objection is that he has not gone far enough.

It is the natural inclination of the majority of men to be producers and not merchants. The central station commercially could be considered a merchant. The engineers and others engaged in operating these companies practically do not manufacture any of the parts that go to make up this plant or equipment; they merely combine these and arrange them in the most attractive form so as to deliver the product to the consumer.

Looking at the situation from a young graduate's standpoint, there are few places in which he can immediately enter the field and his individuality be appreciated. Here again it is a comparison to a large general store. No technical graduate would consider for a moment assuming the management of a large department store, and he would readily realize that before he could successfully manage such a business he would have to devote some time in each department. To the average mind this would appear as drudgery, but it is this kind of drudgery that lays a foundation for permanent success. I believe the number of technical graduates entering the services of central stations is largely on the increase, principally due to the increased size of these companies which offer rapid advancement and a greater variety of work than could be had with smaller companies.

The training received in the work of larger companies is especially valuable, as it enables the young technical graduate to obtain positions of more importance in smaller companies where he can give free rein to his individuality and ability. The young engineer, I believe, realizes more quickly in operating companies the responsibility of his position in life, as frequently early in his career with this company he is placed in charge of some apparatus which through carelessness or neglect may cause serious financial loss as well as interference with the business of the company.

It is only natural that the largest percentage of technical graduates desire to enter the service of the larger manufacturing or engineering companies for the reasons previously stated, although I feel confident those who enter the employ of operating companies and devote the same attention to their work will make more permanent progress.

Philadelphia Electric Company. W. C. L. Eglin.
Philadelphia, Pa.

I regret that I must disagree with Prof. Shepardson's main premises and conclusions. Prof. Shepardson seems to base his article largely upon the assumed premise that few technical graduates become connected with central station companies and he offers reasons for this which include an asserted monotonous routine of central station work, small remuneration, slow advancement and lack of appreciation of true worth in the central station field and greater opportunities elsewhere. These views set forth by Prof. Shepardson are out of harmony with what I have observed of the experience of the men graduating from the electrical engineering course of the University of Wisconsin. Between 15 and 20 per cent of all the men who have graduated from the electrical engineering course of the University of Wisconsin are in the employ of electric lighting, gas lighting, electric power transmission or electric railway companies. Such companies also employ a considerable number of graduates from our mechanical and civil engineering courses. In consideration of the fact that the graduates from our electrical engineering course, besides going into the employment of such companies as stated, go into the employ of manufacturing com-

panies, construction companies, consulting engineers, telephone companies, the signal departments of steam railroads, and other like industrial concerns, it has seemed to me that between 15 and 20 per cent of the men graduating is as large a proportion as the central station people can reasonably expect to obtain.

I have included the gas lighting companies in the foregoing enumeration of station operating concerns because so many public service companies nowadays own both electric lighting and gas lighting plants and operate them in harmony. The graduates from the engineering courses often go into the employ of such companies and work through the manufacturing departments of both branches of the business, as a part of the process of fitting themselves to ultimately become general superintendents or general managers.

The graduates of the University of Wisconsin who have entered and remained in the employ of the electric operating companies have apparently found the field attractive and the employers satisfactorily appreciative of real worth. The advancement of these men has appeared to me to be as rapid as will be found in any branch, and in fact it has seemed to me that the rate of promotion has at times been rapid enough to risk spoiling some of the men. As a rule, the graduates to whom I refer have gone into the employ of the larger city companies, but some of them have gone into the employ of the smaller companies or have ultimately become general managers or owners of such companies after having had experience in the employ of one of the larger city companies.

I also must disagree with Prof. Shepardson when he urges that the "designer and factory superintendent" are of greater importance than the "sales engineer." The really valuable man is the one who possesses and can use the qualifications of both. It is not very difficult to develop a man for chief operating engineer of a small central station who will utilize all the operating economies which can be advantageously introduced. The engineer who is difficult to produce is the man who combines such characteristics with the gumption and attainments which will enable him to meet the customers of his company and deal with them in such a way as to satisfy the customers and at the same time make a profit for the company. According to my experience, the technical college graduates who possess or seem to be capable of developing such combined qualifications are earnestly sought after and highly prized by the central station companies, and they are given ample opportunities for advancement in proportion to the capacity they exhibit.

I will add that it seems to me that the engineering schools of university grade should bend their every effort to producing men with these high-grade qualities. As aforesaid, it is easy to produce a man who can serve as an operating engineer (especially of a small station) when he is under the direction of an able general superintendent or general manager, but it is very difficult to develop the self-reliance, initiative and executive powers of a young man in such a way that he may be equally able within a few years after his graduation to operate a station or manage the affairs of the corporation.

Madison, Wis. DUGALD C. JACKSON.

I do not agree with Prof. Shepardson that a low standard of remuneration is the reason why more technical graduates do not engage in central station work, and many young men will bear me out that this reason is often more apparent than real. A large number of graduates, after spending three to five years with the manufacturing companies at their factories at low wages, and then "on the road," accept positions with the operating companies whose plant they have installed, because of the decreased cost of living, the greater satisfaction of having a permanent home and the greater opportunity for further permanent advancement. Men with such experience are usually more capable of occupying the best positions in the operating companies than men locally trained, as they have a more accurate knowledge of the design and construction of the apparatus, and their road experience has developed their faculty of initiation and made them self-reliant.

Where the central station companies are doing their own engineering and construction work, there are always excellent opportunities for fresh technical graduates, and if these men after gaining experience show executive ability and a faculty for organization, their advancement with the company is assured. My experience has seemed to show that the reasons why so few graduates begin their career in the operating departments are:

First, a reluctance to accept a position where it is necessary to work seven days in the week, and where the opportunity for original work seems limited; and second, because the employer does not desire to employ and train a man, who, after a few months of service, will outgrow his position and resign as soon as he has acquired a sufficient knowledge of the local system and his surroundings to become valuable. For station operating positions men trained and disciplined in organizations like the United States Navy, and educated in the correspondence or night schools, are much more reliable in the routine work and capable of handling emergencies which may arise. In general, central station companies fully realize the value of technical graduates, and offer to such capable men as have had experience in the design and construction of plants the best opportunity for advancement to permanent lucrative positions.

EDISON ELECTRIC ILLUMINATING COMPANY, W. F. WELLS.
Brooklyn, N. Y.

Young men, graduating from technical schools, are attracted most toward construction, next toward manufacturing and least toward operation. The opportunities which present themselves to these beginners are most numerous in manufacturing and least numerous in operation. As a result of the combination of these two conditions, the manufacturing field draws most largely upon the supply of technically-trained young men. This is a desirable situation. A manufacturing establishment is an enlargement of the shops and laboratories in which elementary principles have been taught. Here the means employed in adapting the principles to commercial demands become evident to the observing apprentice. He acquires familiarity with the actual characteristics of modern types of machines. This training prepares him to later adapt and apply the machines and other devices to the requirements of engineering practice. When his work lies in the central station he is able to utilize the capabilities of the machines efficiently, if he knows how they are constructed and under what conditions they give the best results.

As Prof. Shepardson points out, modern central station operation involves the solution of many interesting problems. The technically-trained engineer should find these to his liking, especially if he has sound business sense in addition to his theory. He needs a cool head, good judgment, diplomacy and thoroughness to make central station work profitable. The matter of remuneration will take care of itself, for, as a man shows himself to be possessed of good business characteristics he will be well paid for his work. In my opinion, the best results of a technical education are in the direction of making the students all around men. Such are needed in central station work as well as elsewhere.

CORNELL UNIVERSITY, HENRY H. NORRIS.
Ithaca, N. Y.

Prof. Shepardson's article shows very clearly the benefits to both the technical graduate and the central station in their work together.

From the standpoint of the central station, it is becoming more and more necessary that it have technical men in close touch with every branch of the business. As the cost line and the selling line are getting closer together, it is desirable that each feature of operation be closely watched by some one thoroughly educated in the work. With a man possessing a technical education, it is often possible for him to see and adopt new methods or wrinkles, that are slight in themselves, but in the aggregate are of vast benefit to his company. A man with a technical education can be readily shifted from one branch of the work to another and can easily adapt himself to the new conditions.

I believe that central stations to-day are fully alive to the results that may be secured through the use of technical men. Most plants have made the mistake of depending entirely on one technical man in their operations, leaving the balance of the work to men of practical experience only. This has had a tendency to retard much of the progress that might otherwise have been made had more technical knowledge been exerted in every branch of the business. Success in central-station work depends on results secured, and the technical man has the same opportunity to show his worth as the commercial man. In the long run, the technical man is bound to finish first, as he will have a general knowledge of all branches of the business and is in touch with all parts of it, while with the commercial man his work must largely be of a special nature.

There is a big field for the young technical man in going into central-station work. The opportunities to-day are greater than ever, and with perseverance, activity and resourcefulness, he is bound to come to the top and in time direct the efforts of his fellow workers who have not had his training.

Denver Gas & Electric Company, Frank W. Frueauff.
Denver, Col.

The fact that the majority of young technical graduates enter, or seek to enter, the strictly professional branches of engineering work is probably a natural consequence of the training whose object has been to develop an investigative frame of mind. There is a certain fascination in following and participating in new projects that involve the application of scientific principles, and this in spite of the fact that the remuneration is apt to be considerably less than that received by even mediocre artisans.

But, however praiseworthy the scientific spirit *per se*, the fact remains that engineering proper is essentially a commercial proposition, whose ultimate object is "to do for one dollar what any fool can do for two." The large manufacturing and contracting firms whose product is dependent upon the services of engineering graduates do not employ these men because of philanthropic motives or fanciful theories, but because it pays; they have found that the technical training develops the type of mind necessary for progress.

That so few technical men go into central station work may in part be due to the fact that the owners do not appreciate the benefits to be derived from their employment, and in part to a contemptuous disregard of such work by the graduates themselves, on the ground that it is too largely commercial. The first reason can be overcome in time, just as it was in the case of the manufacturers and contractors. The second requires the young graduate to recognize that there is just as large a field for scientific method in ordinary business as in the more technical lines.

The economical administrations of any commercial undertaking requires close attention to details—the elimination of sources of waste and the improvement of possibilities of growth. Surely, the central station is no exception, for it is a business of details. And it is for precisely this kind of work that the technical man has been found to be fitted by virtue of a systematic training. One of the best friends of the writer is a man who, shortly after his graduation from an engineering school, entered a manufacturing business that involves little or nothing of strictly technical designing; in many years he probably never had occasion to look through a transit, or apply Ohm's law, or integrate an equation; yet he himself declares that his success is due to the mental training he received at college.

A gentleman who is a deep student of history once remarked to me that it is humiliating to consider the number of radical improvements and advances that are due to cranks and lunatics. The curve of progress of almost every kind of human activity is asymptotic in character, rising more or less sharply to a limit, and the sharp rise may be due, as above indicated, to fortuitous or accidental circumstances. But it requires a far higher type of mind, and a greater expenditure of mental activity to make advances when the slowly rising part of the curve has been reached, and this is undoubtedly the condition of central station practice at the present time. Technically-trained men are needed if development is to go on. It will possibly require some time to effect a mutual understanding of the benefits to be derived from a closer relationship between central station owners and trained engineers, for the one must learn that it will pay, and the other that it is worth his while. If these direct reasons should fail, however, the adjustment will come through the simple economic consideration that the increasingly large number of technical graduates must find new fields of usefulness.

Washington University, A. S. Langsdorf.
St. Louis, Mo.

I have read with much interest the article on "Technical Graduates and Central Stations," by Prof. Geo. D. Shepardson, and think it a most excellent contribution to the subject, and very timely from the fact that the public is demanding better service, while the central stations are assuming greater responsibilities in the field of electric light and power work. It seems to me, to make a central station successful, especially from a financial standpoint, the best engineering ideas and methods must be used, and to do this successfully it certainly requires a technical man who has had training in both the electrical and mechanical engineering departments. I cannot, however, agree with Prof. Shepardson that syndicate ownership of public utilities is broadening the field for our young engineers. Syndicate ownership means a reduction of expenses in both the operating account and fixed charges, and while it is true the chief officers and engineers of the large syndicates are paid large salaries, I think it is also true that the engineering skill as well as responsibility of operating departments in the different companies of which the syndicates may be composed, is assumed by the heads of the parent corporation, and consequently a low salaried man is used to carry out their instructions. This condition of affairs will make the field for young engineers much less attractive than it otherwise should be.

Iowa City Electric Light Company, Geo. S. Carson.
Iowa City, Ia.

The article on "Technical Graduates and Central Stations," by Prof. Shepardson, in your first issue of the year is very opportune. The conquest of the central station business by the technical graduate which is now going on cannot but interest all who are connected with the electrical industry. It appears that in the appreciation of the output of the engineering schools the central stations are just now going through the same transition period that the manufacturing concerns passed through a number of years ago. In this matter the larger stations are naturally in advance of the smaller.

Anyone who has occasion to visit the smaller central stations throughout the country, often has opportunity to note cases where the methods with which the technical graduate is familiar, would, if applied, more than save the additional expense of such a man. Three particulars in which this is especially true are the handling of the boilers, the keeping of records of operation and the maintaining of the proper degree of accuracy in the customers' meters.

Ohio State University, F. C. Caldwell.
Columbus, Ohio.

One answer to the timely question asked by Prof. Shepardson in your current issue, "Why are so few technical graduates connected with central stations?" may be that it is easy for the professor in charge of our electrical courses to honor the requisitions of the big manufacturing companies for men, and so exhaust the supply. It may be that a neighboring central station open to graduating students does not offer an attractive field, and that the student is thereby more strongly drawn toward the manufacturing or construction work so freely offered. Possibly the professor has not cultivated the acquaintance of the central station managers sufficiently to know the great opportunities in this work, or has not impressed said managers with the value of the instruction imparted as preparing students adequately for it. Sometimes the manager who has tried a tech-

nical graduate finds him too ingenious or short-sighted in his schemes for economy, as in changing the number of machines in parallel so often as to annoy customers by the accompanying flicker of lamps, assuming the change to be unskillfully made.

The fact is, it seems to me, that central station managers are now learning that the properly-trained graduate is valuable to them, and will make the positions more and more attractive, when they realize the great possibilities of obtaining not only technically-trained, but loyal men; for I believe that the education of the engineer makes the graduate more zealous in conserving his employers' interests than the average man.

It has seemed to me that our technical laboratories are much better prepared to demonstrate and give practice in paralleling of alternators and in illustrating line losses for example, than to design and build apparatus, that as a rule will not equal what can be bought. To-day our laboratory switchboards are designed quite as much for the actual operation of machines in series or parallel, and for the representation of long-distance power transmission, as for the taking of characteristic curves, or the determination of wave form by oscillograph. Young men find more enjoyment in the carrying out of elaborate synchronizing experiments to determine, for instance, the safe operative phase difference for a given pair of machines, than in the designing of a generator never to be built.

Prof. Shepardson's paper suggests the advisability of interesting station men in our laboratory facilities, in getting them to bring their problems for solution to the colleges, with the double purpose of providing experiments of vital interest and of preparing our students for operating work. There is a fascination in acquiring facility in proper synchronizing similar to the skillful handling of a tiller or the steering wheel of an automobile. The path to the manager's chair is just as direct through the operating of large switchboards as it is through the drafting room of a manufacturing concern. In operating the young graduate will quickly learn that efficiency and economy are dearly purchased if reliability be sacrificed, a truth that must be accepted by the graduate before he can become an engineer.

UNIVERSITY OF ILLINOIS, MORGAN BROOKS.
Urbana, Ill.

Street Railways of the Empire State.

The New York State Railroad Commission in its annual report gives data as to the electric railway systems of the State. The assets of the street surface roads are $773,854,039.74; liabilities, $761,814,611.67; gross earnings, $78,819,304.09; operating expenses, $43,501,438.27. The miles of road operated are 2,157,847. The increase in mileage during the year was 60 miles. Horse cars dropped from 3,643 in 1905 to 3,390 for the past year. Total cars in operation, 15,837, of which 4,869 are equipped with power brakes.

The companies employ 43,285 persons, and paid salaries and wages amounting to $28,882,153.60. The percentage of dividends to capital stock was 5.05. The total passengers were 1,913,433,019; transfers, 378,415,828; tons of freight, 1,603,182. In 1899 the freight tonnage was 129,040. The passengers carried in Manhattan and the Bronx were 630,297,151, an average of 1,726,841 per day. The Manhattan Railway carried 257,796,754 passengers and the subway 137,919,632 during the year. In Brooklyn the total was 492,659,270, an average of 1,349,751 per day. The percentage of operating expenses of all street surface roads to gross earnings was 55.19; in 1897 it was 60.57.

During the year 317 were killed and 2,014 injured on street surface roads, as against 240 killed and 929 injured in the previous year. The increase in injured was mostly in Greater New York. Sixty-three of these killed were passengers and twenty-eight employes. Last year there were 30 passengers and 29 employes killed. Of the killed passengers, 45 were caused by getting off cars in motion. The injured included 1,037 passengers and 101 employes.

Niagara Power for Canada.

The subject of the delivery of electrical energy from the Canadian Niagara plants into the United States has been taken up by the Canadian section of the International Waterways Commission, which has reported on the subject. Referring to the applications made to Secretary Taft, it says these cover the proposed export into the United States of power as follows: Ontario Power Company, 90,000 hp; Canadian Niagara Power Company, 125,000 hp; Electrical Development Company, 62,000 horse-power.

Final action has not as yet been taken, but in the meantime it has been recommended by the American section that permits be granted as follows: Ontario Power Company, 60,000 hp; Canadian Niagara Power Company, 60,000 hp; Electrical Development Company, 37,500 hp; International Railway Company, 2,500 hp. The report says:

"In the opinion of your commission, if any treaty be had with relation to use of these waters, the proportions recommended and agreed upon by the joint commission should be adhered to. The Ontario Power Company, through its ally, the Niagara, Lockport & Ontario Company, has built transmission lines in New York State, in duplicate and in branches, throughout a territory 150 miles long and 20 miles wide, at an expense of upwards of $4,000,000, and for several months has been delivering power at the extreme end of the line. This company has not so far made any serious effort to supply the Ontario market with power.

"The Electrical Development Company, which is more particularly a Canadian corporation, has built a transmission line to the City of Toronto. They have qualified themselves to produce about 50,000 hp in the immediate future. This company is making strenuous efforts to secure immediate permission to export to the United States power to the extent of 53,000 horsepower.

"In view of these conditions, and of the special advantages which will be created by a treaty arrangement, your commission would respectfully reiterate the views which they expressed in their report of the 25th of April, 1906, that your government, while fully recognizing the rights of these corporations, should so control the export of power from Canada as to protect public interests.

"Your commission are of opinion that when each of the companies, in their agreement with the Park Commissioners, stipulated that they would, 'whenever required, from the electricity or pneumatic power, generated under this agreement, supply the same in Canada (to the extent of any quantity not less than one-half the quantity generated), at prices not to exceed the prices charged to cities, towns and consumers in the United States, at similar distances from the Falls of Niagara, for equal amounts of power, and for similar uses,' they do not comply with the conditions of their agreement unless and until they have severally or jointly built transmission lines in Canada to an equal extent as in the United States.

"Your commission is of opinion that it was of the spirit of the agreement, if not the letter, that the companies should themselves reach out to and supply the Canadian public, and that it is not a fair interpretation of the agreement that Canadian consumers should be expected to build transmission lines to Niagara Falls as a condition of receiving any benefit from this public utility.

"Irrespective of any agreement, private corporations using the natural resources of Canada, should, in the opinion of your commission, be compelled to operate the same so as to afford adequate service in the first place to the Canadian public, and export of power at Niagara should only be allowed to the extent of the surplus after the Canadian market has been fully supplied under reasonable conditions and a fair price."

On the strength of these recommendations that Mr. Aylesworth has introduced his bill into the Commons to limit or forbid the export of power from Canada into the States. This measure would seriously imperil, it seems, a large investment already made.

Substitution of the Electric Motor for the Steam Locomotive.

At the January meeting of the American Institute of Electrical Engineers Messrs. L. B. Stillwell and H. St. Clair Putnam presented a valuable paper dealing with the very live and timely topic of the substitution of the electric motor for the steam locomotive. The paper contained a considerable collection of data gathered from the operation of various interurban electric lines, the elevated railways in New York City and the Valtellina three-phase line. These data were compared with results with steam locomotives compiled from the reports of the commission. On the basis of the above comparison it was shown that the total cost of operation by electricity would be 82 per cent of that by steam locomotives. The comparison dealt with the maintenance of way and structures, maintenance of equipment, conducting transportation and general expenses; no financial value was placed on the factors which tend to increase earning power with electric traction.

The authors stated that the engineers constituting the membership of the Institute owe it to themselves, as well as to their clients, to use every effort without prejudice and without fad, to prevent waste by opposing the introduction of apparatus which, from its limitations, cannot solve the general problem of railway electrification, and they should use their united influence to fix proper standards as rapidly as this establishment may be consistent with progress. Specifically it would seem feasible and eminently wise to agree upon standards of practice in respect to the following: *a*. Location of third rail. *b*. Location of overhead conductor used with single-phase alternating-current system. *c*. Frequency of alternating-current traction systems. It is equally desirable, but probably less easy, to agree upon a standard system of multiple-unit control for train operation. After discussing the recognized advantages of continuing the use of the present standard frequency of 25 cycles, the overbalancing advantages of 15 cycles for railway motors were outlined. In the case of multiple-unit equipment of passenger cars where locomotives are dispensed with and motors carried upon the car trucks, it is very important that the dimension of motors be reduced to a minimum. The difference between the dimensions of a 15-cycle and a 25-cycle motor may easily be the controlling consideration compelling the adoption of the four-motor equipment. In the application of single-phase commutating motors to locomotives in general railway service, the minimizing of motor dimensions is perhaps still more important, although in this instance the limitations imposed by the space available are less obvious. There can be no question of the superiority of the 15-cycle motor in respect to the very important features of commutation, efficiency and power factor.

The discussion was opened by Mr. Frank J. Sprague, who remarked that the statistical information given by the authors was based almost entirely on direct-current operation, yet they plead for standardization of electric railway apparatus along the lines of operation of an 11,000-volt trolley using alternating current at 15 cycles. He stated that ten years from now the 600-volt direct-current equipment will be where it has been for the past nineteen years, right here. If the Pennsylvania road were called upon to be electrified from New York to Philadelphia, the selection would not be the overhead single-phase equipment whether of 25 or 15 cycles, but would be direct current. On a large number of lines the 1,200 or 1,500-volt, direct-current system will give better results in every way than any alternating-current overhead system.

Mr. B. G. Lamme discussed the question of frequency and outlined the important part which Mr. Stillwell had played in the reduction of frequency from 133 cycles to 60 cycles, and then subsequently to 25 cycles, when the Niagara Falls work was first undertaken. He stated his belief that the field for application of the single-phase commutator motor is so large that it need not be handicapped by the requirements of any other equipment. The most important reason for changing from 25 cycles to 15 cycles relates to the increased output that can be obtained from a certain motor. Thus a 100-hp, 25-cycle motor becomes a 125-hp, 15-cycle motor. The motor in itself is equally efficient; the power factor is just as good and the commutation equally as good. It is not a question whether the 25-cycle motor will do the work. The increased output that can be obtained from a motor at the lower frequency is of advantage in allowing a smaller number of motors to be used under a given locomotive. The single-phase series motor can operate both on 25 and 15 cycles at practically the same speed. The 15-cycle motor if well designed will operate on 25 cycles fairly well at slightly reduced capacity. A motor equipment normally designed for 25 cycles will operate excellently on either frequency if 15-cycle transformers are provided.

Mr. B. J. Arnold did not agree entirely with the authors of the paper that railway equipment should be standardized at once and thereby shut out the prospect of developing something that may prove better than anything in use at present. He stated his belief that 15 cycles will be adopted finally on account of the necessity of getting as much motor capacity in a limited space as possible. The weight of the equipment is practically the same, whether 25 or 15 cycles are used. A frequency of 15 cycles requires an increase in the size of the transformer, but reduces the size of the motor and the total weight is the same, but it provides additional power at the drivers. Some form of high potential overhead conductor will be the final solution of the railway problem. The legislation of this country will come to a point where the use of the third rail will not be permitted, especially in exposed places.

Mr. W. B. Potter heartily endorsed the recommendations of the authors for a more perfect standardization of the systems and apparatus for railway work. There is no doubt that the rest of the equipment must be subordinated to the motor, which is limited by the space between the wheels, the car body and clearance over the track. It is possible to build a motor having good commutation for 25 cycles, and such a motor will weigh perhaps 25 per cent more than a corresponding direct-current machine. With 15 cycles and the same degree of commutation the motor will probably weigh only 10 or 15 per cent more than the direct-current machine. The efficiency and the power factor will be practically the same for 25 and 15 cycles. A long series of tests showed that the tractive effort of a 15-cycle motor is from 70 to 80 per cent that of the corresponding direct-current motor, while the 25-cycle motor has a tractive effort from 80 to 90 per cent as large. When the direct-current motor slips the wheel rotates rapidly and the torque falls off immediately to something like 20 or 30 per cent of the maximum. With either a 15 or a 25-cycle motor all of the wheel slips at a lower point, the torque falls off only from 10 to 15 per cent, due to the fact that the slip is a series of progressions or jerks which allow the wheels to grip the rail. The average draw-bar pull after slipping with alternating current is perhaps 70 per cent greater than it is with direct current. It is not proper, however, to ignore the fact that considerable improvements have recently been made in direct-current equipments. By the addition of commutating poles to an ordinary 600-volt motor, it can be run at from 1,000 to 1,200 volts without showing any sign of sparking. As far as commutation is concerned, the recent improvement made in the direct-current motor is comparable to the advance made when the carbon brush was substituted for the copper brush.

Mr. W. S. Murray reported the results of some observations made upon steam locomotives, which showed that their average maintenance cost was 6.68 cents per locomotive mile. This item is of interest when compared with the cost of repairs on the electric locomotives used on the Valtellina line, where a value of 1.8 cents per locomotive mile was obtained.

Mr. O. S. Lyford remarked that the Erie Railroad on January 22 placed in commercial service an electric traction system which embodies most of the features which the authors have assumed as probable characteristics of the standard of the art. A total weight of train 22 per cent heavier than that for which the motors were designed has been successfully hauled on an icy, slippery rail. An 11,000-volt trolley wire supported by an

overhead catenary construction is entirely safe. The high-voltage wires on the car are so short and so well guarded that they are not a source of increased danger, and all of the other wires are operated at only one-half of the usual voltage. The system is necessarily operated at 25 cycles, because the electricity comes from one of the Niagara Falls plants. The advantage of the lower frequency is apparent, however. Trucks of unusual size are entirely filled with 100-hp motors. If the frequency were 15 cycles, 150-hp motors could be used on the same trucks. Studies of different specific railway problems have shown that the adoption of electric traction if a high-voltage trolley is used will in no case mean an operating cost greater than with steam, and in practically every specific case the saving is considerable. Engineers ought not to waste much time in discussing the details, but should place emphasis on the one great fact that electric traction can be adopted with considerable advantage by the present steam railroads.

Mr. C. de Muralt compared the performance characteristics of the New York Central direct-current locomotive, the New Haven single-phase locomotive and the three-phase Valtellina locomotive and several representative steam locomotives. He showed that the tractive effort of the steam locomotive drops off rapidly as the speed increases. The same is true of both the direct-current and the single-phase locomotives, but the three-phase locomotive maintains its tractive effort practically up to the maximum speed for which the locomotive is designed.

Mr. A. H. Armstrong stated that there is a demand for a type of locomotive which can surpass the best performance of the steam locomotive as constructed to-day or as foreseen in the future. In the electric locomotive there has been produced a piece of apparatus which under an endurance test of 50,000 miles has had a maintenance charge of less than 1.5 cents per locomotive mile, and has a concentrated horse-power of 22,000, and is capable of giving 50 per cent increase for unlimited periods with forced ventilation. With the electric locomotive the engineer can approach great problems in railroading with supreme confidence of meeting all requirements. A steam locomotive having a capacity of 500 tons trailing on a 2 per cent grade will be superseded by an electric locomotive that will give double speed or double the trailing tonnage. It seems childish to discuss such details of construction as frequencies and types of apparatus when the main problem is the substitution of the electric motor for the steam locomotive.

Mr. N. W. Storer contended that the problem of the electrification of steam railroads resolves itself into dollars and cents, and that a system which can be installed and operated for the least money will be the one to succeed to the exclusion of all others. Upon comparing the direct-current locomotive, the single-phase and the three-phase locomotives it was found that the single-phase locomotive offers the greatest possibilities. Every time the single-phase locomotive is considered for heavy work the problem of the frequency makes itself manifest, and if the choice were unlimited 15 cycles would be adopted. As regards the lighting of the cars, it is to be noted that illumination by 15-cycle current is entirely satisfactory when low-voltage, heavy-filament lamps are employed.

Mr. William McClellan remarked that in spite of the fact that the single-phase motor must be heavier than the direct-current motor for the same power developed, and it is necessary to divide the sub-station into pieces and carry it around with the locomotive, thereby making a large amount of ton miles in the course of a year, as a whole the single-phase system provides a better solution for trunk line electrification than any other that has been in sight up to the present time, particularly if the frequency is placed at 15 rather than at 25 cycles. There seems to be practically nothing in the way of the standardization of this frequency for railway work. Although it is not absolutely essential for interconnecting railways to exchange locomotives, yet if lack of standardization prevents the interchange of cars it will be practically impossible to electrify the railroads of this country on a wholesale scale. It seems desirable, therefore, to standardize certain features immediately, such as the height of the overhead trolley, and the location of the third rail in the almost unknown places where it will be adopted in the future. In spite of the fact that the two great manufacturing companies in this country have two different systems of multiple-unit control, there is no reason why the train line should not be standardized and why it would not be possible to have one kind of train line for both systems.

Mr. W. I. Slichter remarked that there could be no doubt that for electric railway work a frequency of 15 cycles is better than one of 25 cycles. The output of the motor may be increased by from 30 to 35 per cent by a decrease in frequency to 15 cycles. The other parts of the system, except the transmission itself, are, however, affected in a reverse way. The generator itself may be increased in cost by from 15 to 50 per cent, and the transformers by 20 per cent, but there may be a decrease in the distributing system of 10 per cent.

Prof. J. B. Whitehead thought that the determining characteristics of a successful locomotive refer to the extent to which the vehicle is self-contained and the greatest power than can be gotten into the space available for the motors. From the standpoint of self-containment, the position of the direct-current motor need not be yielded to the alternating current. He asked if there is any instance on record where there have been unpleasant results from an increase in potential due to a broken bond. In reply Mr. Stillwell stated that he had no knowledge of any case in which danger had occurred from that cause, but in the estimates for the single-phase system a 4-0 conductor had been assumed in the return circuit. He stated that the question of frequency was settled decisively by the testimony at the meeting in favor of 15 cycles. The steam railroads have standardized everything relating to the interchange of traffic; electrical roads must follow that precedent or they will get involved in all sorts of trouble.

Contracts for New York Subways.

The committee on plans and contracts of the Rapid Transit Commission has submitted, for the action by the full board, a draft of the contract for the construction of the Lexington Avenue subway. This contract is drawn so as to provide two alternatives: for construction alone and for construction, equipment and operation. The contract if approved by the corporation counsel and the Board of Estimate, will be adopted for all future routes. The contractor is required to deposit $1,080,000 if he bids for the construction of the entire route. This is about 3½ per cent of the contract price. For part of the road the deposit will be proportionate. This deposit will be returned when the road is accepted. A bond for an amount equal to the deposit will be required, to be cancelled when the contract is completed, if the contract be for construction only. If the contract be for construction, operation and equipment the bond will be continued to secure payment of rentals. Ten per cent of all payments will be held up until the work is accepted. This means that the city will have 17 per cent of the cost of construction as security for the proper performance of the contract. The work will be divided into seven sections and contractors may bid for one or more sections. Adequate pipe galleries will be installed throughout the route, with the exception of two short spurs.

The operating rental will be the interest paid by the city on its bonds issued for construction purposes, plus 1 per cent. All bonds used in acquiring rights, purchasing land, etc., will be included in making the computation for rental purposes. The equipment will include rolling stock, power houses, electrical devices, rails, ties and ballast. The city will have a lien on this equipment in case it should decide to declare the contract forfeited because of failure to comply on the part of the contractor. In order that there shall be no doubt as to the powers of the commission to supervise the operation of the road, a clause provides that the commission may order the operating company to add rolling stock and equipment when necessary, and change methods of operation when ordered.

CURRENT NEWS AND NOTES.

SONS OF JOVE.—The Sons of Jove held two rejuvenations during the period of the Chicago Electrical Show, January 16 and January 26, and initiated about 78 members.

BELGIUM BUSY.—United States Consul-General George W. Roosevelt writes from Brussels that the Belgian State Railroad Department is now studying plans which will necessitate changing the single line roads into double tracks, and later for the application of electricity.

THE HELION LAMP.—Prof. H. C. Parker, of Columbia, and his associate, Mr. Walter G. Clark, will present a paper on the new Helion lamp on Tuesday, February 5, at 8.15 p.m., in room 301, Engineering Building of Columbia University. All interested are cordially invited to attend.

EIFFEL TOWER WIRELESS.—A special dispatch from Paris, January 25, states that the recently established wireless telegraph service from the Eiffel Tower in Paris to Bizerta, Tunis, is working admirably. Messages have been exchanged correctly between the two points for several days.

POLICE WIRELESS SYSTEM.—The dome of the new building for police headquarters in New York City has been equipped with a wireless telegraph system for use in emergencies and in case the regular police alarm system should become disabled.

ELECTRICITY IN NORWAY.—Mr. E. S. Cunningham, Consul at Bergen, states that an increased interest has been manifested in Norway for the development of water powers, and it now seems certain that in the near future several hydroelectric plants will be built. Construction work is proceeding on a 50,000-hp enterprise on the Tysse River, in connection with which a calcium carbide factory will be one of the industries.

THE ELUSIVE NICKEL.—There are nine two-cent fare bills before the Indiana legislature and one one-cent interurban fare bill. The latter will not pass, and the steam roads are not fighting the former, but they ask that an additional cash fare may be exacted on trains from those who neglect to procure tickets. The addition asked for is from ½ to 1 cent. The authors of these bills are not willing to allow this penalty since the Machiavelian railroads might reduce the number of ticket sellers and ticket officers and force passengers to pay cash fares.

NOVEL TUNNEL CARS.—The steel cars for the Hudson Companies' tunnels under the river, between the New York and New Jersey shores, will contain a number of novel features. Posts extending from floor to roof will be used instead of straps, and the cars will have double doors at the center as well as end doors. The center doors will be operated pneumatically. The floors will be of cement in which will be embedded carborundum to prevent slipping. Such a floor can be easily washed and the abrasive carborundum is expected to wear longer than metal. The station at Cortlandt Street, New York, will contain five tracks and separate platforms will be used for receiving and discharging passengers.

MINERAL RESOURCES.—It is announced that the different chapters in future volumes of the series "Mineral Resources of the United States," which the United States Geological Survey has been publishing for the past 21 years, will be written by members of the Survey. In this report they will differ from their predecessors, which have been prepared mainly by outside experts for each of the mineral industries, working under appointments as special agents of the Survey. This corps of experts included such distinguished men as Messrs. Charles Kirchhoff, George F. Kunz, James M. Swank, Joseph D. Weeks, Charles D. Yale, John Birkinbine, Joseph Hyde Pratt, F. H. Oliphant, Heinrich Ries, Edmund Otis Harvey, F. J. H. Merrill and others. In the introduction to the last volume, which covers the calendar year 1905 Dr. David T. Day, chief of the division of mineral resources, in making this change, acknowledges his great indebtedness to them for their monumental work in building up and maintaining this series and his personal regret at the breaking of the ties of a score of years of joint endeavor.

NEW YORK WAGES.—The directors of the Interborough Rapid Transit Company have increased the wages of trainmen, conductors, gatemen, agents, platform men and switchmen. In other departments of the company, including the car equipment, mechanical and maintenance departments, an increase was also voted. The increases made add $400,000 to the payrolls. The company announced that the increase was voluntary, and that it had increased wages of many classes of employes, "appreciating the services which are being rendered in handling the very large increase in traffic in the Subway and on the elevated lines in such a generally satisfactory manner." The new schedule, which becomes effective February 1, allows trainmen in their first year $1.80 a day, instead of the $1.70 now paid. After the second year they will receive $2.00. Conductors' wages remain the same with the exception that after the third year they will receive $2.50, an increase of ten cents a day. First year gatemen will receive $1.70 a day in place of $1.50, and in the second year $1.80 instead of $1.55. Agents receive $1.90 for the first year and after that $2.10, an advance of fifteen cents and ten cents, respectively. The wages of platform men who have been getting $1.75 are raised to $2.00, and after the first year to $2.10. Hand switchmen receive the same pay they have been getting, $2.25 for the first year, after which they receive an increase of twenty-five cents.

INDUSTRIAL SAFETY.—The exposition of safety devices in this city under the auspices of the American Institute of Social Service was prefaced by a banquet at the Waldorf-Astoria on January 28, at which Governor Hughes made an admirable and impressive address before a large and notable gathering. The exposition is being made from January 29 to February 12, at the Museum of Natural History, Central Park, and is attracting much attention on the part of the public. There is no charge for admission. The display includes machines or devices in operation, models of actual or reduced size and photographs. Wood and metal-working machinery, stamping, grinding and polishing machines; presses, textiles, the building trades, safeguarded elevators, windlasses, cranes and hoisting machinery; transportation security by sea and land, safety lamps and explosives, quarrying, agricultural and chemical industries; safety from fire. The section of industrial hygiene include improved dwellings, first aid to the injured, prevention of tuberculosis and other dread diseases harmful to the life of workmen, respirators and devices for supplying and maintaining pure air and industrial betterment. To each exhibitor a diploma will be presented, designed by one of the foremost artists of America. A handsome plaque medal has been made. Its obverse shows a graceful figure of a woman against a background of machinery and the legend is "Security for Humanity's Sake." On the reverse is, in panel form, "First International Exposition of Safety Devices and Industrial Hygiene by the American Institute of Social Service."

A BRITISH MINISTER.—Mr. John Burns, president of the British Local Government Board, is known for his intemperate advocacy of government ownership. He was one of the promoters of that dismal failure, the municipal council steamer fleet on the Thames. A cable dispatch from London of January 26 reports the following incident: "Justices Darling and Phillimore, sitting in the King's Bench Division of the High Court of Justice, to-day refused an application to commit John Burns, president of the Local Government Board, for contempt of court in delivering a speech in which he commented upon a case which is in the courts. The justices, however, charac-

terized the minister's speech as being one of extraordinary indiscretion and impropriety. The application was made in behalf of a London newspaper, which is now being sued by members of the London County Council for alleged libelous statements relative to their policy as members of the Street Railroad Committee of the Council. Mr. Burns, at a public meeting on January 24, severely condemned the newspaper's statements on the subject and declared they were calculated to prejudice a fair trial. In refusing to commit Mr. Burns the justices declared that his 'language was so extravagant' that it could not prejudice the trial of the case. They also said that they considered the speech to be 'very unusual and regrettable,' and they could not 'recall a previous instance where a minister of the Crown had thought it consistent with his public duties to take sides in a litigation before the courts.'"

FUNERAL OVER TELEPHONE.—At North Cos Cob, Conn., the widow of a local clergyman was able last week to participate in the funeral exercises over her husband, by means of a special telephone installed for the occasion between the church and the parsonage.

TELEPHONE REGULATION.—The Cumberland Telephone & Telegraph Company has caused to be submitted to the general assembly of Tennessee a memorial asking for the creation of some State tribunal with ample power and authority to make full investigations, and to hear and adjust all complaints made against the telephone companies doing business in the State. The memorial sets out at length that each two years, at every sitting of the legislature, effors are to be made to pass laws to remedy supposed evils in the business, and that statutes are sought which impede the growth of the companies and causes losses to the public at large.

ARGUMENT BY TELEPHONE.—Judge Sharpe, of the Supreme Bench, Baltimore city, sitting in a telephone booth in New York City last week, heard arguments of a case over the wires from the City Solicitor's office in Baltimore. The case was that of the city against the Canton Company over the title to Canton Park, wanted as an addition to another of the Baltimore parks. The City Solicitor desired the case to be sent up to the Court of Appeals by Saturday. Judge Sharpe wired the parties to have the bill prepared. This was done and Assistant City Solicitors Ritchie and Goldsmith argued the case over the long-distance telephone, just as effectively as though all the proceedings had been conducted face to face.

PROGRESS IN SALVADOR.—Mr. W. C. McEntee, engineer of the Compania de Luz Electrica of Santa Ana, Salvador, C. A., informs us that the company has been in business for the last 14 years, the first plant having been established in July, 1902. It is doing a good business and is now installing a new plant 7½ miles from the city, where it will develop over 500 hp, using Westinghouse generators to a capacity of 300 kw, driven by Pelton wheels under a head of 63 ft. Later on the company expects to extend its system to two other towns, one 12 miles distant and the other 6 miles. With this plant the company is going to initiate a day circuit and will deliver electrical energy to small factories as well as for general heating, cooking and sugar refining purposes. It would like to hear from manufacturers of apparatus for the last two purposes.

TIDAL POWER.—Senator Sewall, of Bath, has presented a bill to the Maine Legislature in which he asks the committee on appropriations to set aside the sum of $5,000 to be paid the inventor of a successful mechanism for the utilization of Maine's tidal power. Maine has the longest coast line on the Atlantic seaboard, but in many instances the history of its coast towns is one of depleted population. Senator Sewall believes that if tidal power can be made cheap and practical it will relieve this situation, as many useful industries would soon be established. Tidal mills now in disuse served in the manufacture of lumber and other products, the operation of grist mills, etc., and Senator Sewall hopes they may again be utilized, but in a more modern and practical manner, with electricity as a means of storage.

BOSTON SUBWAYS.—Another subway system is projected for Boston. Representative Bennett introduced last week in the Massachusetts Legislature the petition for a subway and tunnel from Park Street to the junction of Beacon Street, Commonwealth Avenue and Brookline Avenue, to accommodate all cars from places lying west of Boston. The proposed route of the subway is from Park Street to a point near the Union Boat Club, thence under the Charles River embankment in the rear of Beacon Street to the Fenway, thence under the Fenway to the terminal at the junction point above mentioned. The reasons for the introduction of the bill are that something should be done to improve transit facilities east and west, and that at this time the cost of building such a subway would be comparatively slight on account of the excavations for the Cambridge subway and the construction of the Charles River dam and embankment.

M. O. IN LONDON.—A cable dispatch from London of January 19 says that the agitation against municipal socialism in London is rapidly taking shape and claiming a large share of public attention, although the election is six weeks off. The papers publish daily fresh exposés of the economic failure of experiments in municipal trading by the County Council and local boroughs and it is beginning to become apparent that even boasted successes have been really lamentable failures. A circumstance especially resented is that misleading and unbusiness-like methods of bookkeeping have made losing operations appear to show profit. The principal which the municipal reformers are advocating in the present campaign is that no municipality is justified in undertaking a commercial enterprise except under two conditions—the proposed industrial service must be of a nature necessary to civilized communities' welfare and private enterprise must have failed to perform the service. This is the issue on which the campaign will be fought and there are already indications that it will result in important changes in the present constitution of the council.

ELEVATED FOR RIO DE JANEIRO.—United States Consul Anderson, of Rio de Janeiro, reports that one of the last acts of the retiring administration of Brazil was the granting of a seventy-year franchise to Carlos Schmidt and others, of Rio de Janeiro, for the construction of an elevated railroad to serve the city of Rio de Janeiro and its suburbs. This franchise was obtained for an American company. It represents a purely American enterprise and present plans are that all the equipment will be purchased in the United States. The company, according to statements made by its projectors in Rio de Janeiro, was organized a short time ago in the State of South Dakota and was capitalized at $50,000,000. Charles E. Browne, of New York City, is its president. It is planned to send engineers and technical experts to Rio de Janeiro in January to commence the preliminary work. Within four years 1⅗ miles must be in operation. Plans call for about 60 miles of right of way, which is to be double-tracked throughout. The third rail electric system will be used. Electrical power will be obtained from its own plant or from one of the two great concerns now preparing to develop water power in the mountains near Rio de Janeiro. It is planned to establish a local and a through service for the benefit of the people living in the suburbs. The projectors estimate that the first year's business on a full working basis ought to show the carriage of passengers to the extent of many times the population of the city at present. For its privileges the company holding the concession must pay the municipality 50,000 milreis per annum for the first year, 60,000 milreis per annum for the next thirty years, and 70,000 milreis per annum for the following thirty years. At present exchange this would amount to $16,666, $20,000 and $23,333 per annum, respectively.

RUSSIAN TELEGRAPHS.—The *Journal de St. Petersbourg* states that the Russian Government intends, as soon as possible, to improve the telegraph service of that country by constructing lines to link up the small outlying towns with the chief towns in each district.

LIFE SAVED BY TELEPHONE.—Last week at the prison at Centerville, Mo., a respite was received from the Governor of the State by telephone. No trains reach the town and there is no telegraph line; and but for the telephone the condemned prisoner would have been executed.

DON'T DYNAMITE—TELEPHONE!—It is reported from Persia that the new Shah, in order to be accessible to the public but not to run the risk of being dynamited, has ordered the installation of a telephone line between his palace and a public square. Any citizen who wishes to make a complaint in regard to any matter in which he considers himself aggrieved can communicate with the Shah directly over the telephone line.

TELEPHONE EMPLOYES.—Owing to the ruling of the State shop inspector, the telephone companies of Ohio have been obliged to cease employing girls under eighteen years of age as night operators. Young girls have usually been given the night work, because its duties are lighter than during the day. The rule has caused considerable trouble in changing the girls around to places they are able to fill, and in many cases the older girls objected to being put back on the night staff.

SPANISH TELEPHONY.—U. S. Consul Louis J. Rosenberg, of Seville, writes that the Spanish Government has just taken over all the property and rights of the Interurban Telephone Company, and will operate it under the same rates and conditions. In this connection the consul states that when the Spanish Government will be ready to perfect its lines and to complete its system of long-distance and interurban exchange there may be a possibility for American manufacturers of telephone apparatus to do some business.

A CORRECTION.—In the article by Mr. Wm. O. Eddy on the "Design of a 12-in. Induction Coil," appearing in the first issue of January, several typographical errors appear. On page 41, in the eighth line under the head "The Insulating Tube," the ratio should be $1:\sqrt{2}$ instead of $1:1/12$. Eleven lines below the head, "The Secondary," on the same page, the volts should be 170,000 instead of 17,000. The word "volts" on fifth line of second column should be "kilovolts." On page 42, eight lines from the top of the second column, and also on line below, 1,375 ft. should be 1.375 ft.

DEADENING AN INDUSTRY.—Figures are cited by the New York *Times* to show that in Great Britain and Ireland electric lighting is supplied in 457 places, although the number should be 1,256 to equal the proportion in operation in the United States. If Great Britain were as well supplied with electric railways as the United States it would have 14,000 miles instead of 3,040. If Great Britain used the telephone as much as the United States there would be 50,000 employed in the industry instead of 13,000. The *Times* argues that municipal and government ownership has proved a great blight on public utilities in the United Kingdom.

WIRELESS IN THE YUKON.—The De Forest Wireless Telegraph Company has submitted a proposition to the Dominion Government for the installation of wireless telegraph stations to bridge over the dangerous portion of the route of the government telegraph system between Ashcroft and Dawson City, which, by reason of avalanches and wind storms, is so liable to interruption in the winter time. The company wants a subsidy of $50,000 for installation of its plant and a further subsidy of $50,000 for each year it is in operation. The company undertakes to cut existing tolls in half. They are $4 for 10 words. It is contended that this is an advantageous proposition for the government, as the annual deficit in working the government Yukon telegraph line is $100,000.

WESTERN PASSENGER RATES.—Advices from Chicago state that Western electric lines are aiding steam roads in the fight against the 2-cent per mile rate. In order to head off this legislation, Western roads will propose a 2½-cent rate in Iowa, Wisconsin and Minnesota. It is a new thing to see the electric and steam lines associating in this manner. The steam lines are having to lower their rates in order to retain any considerable portion of patronage in passenger traffic. The fare from Canton to Akron by steam is 70 cents and by electric 35 cents; from Cleveland to Akron it is $1 and 60 cents, respectively; from Columbus to Newark the same rate prevails, and from Newcastle, Pa., to Youngstown, Ohio, the rates are 65 cents and 30 cents, respectively. But there is a limit where both systems alike begin to lose money.

SOUTHERN ELECTRIC ROADS.—With regard to developments in the South, the *Manufacturers' Record*, of Baltimore, says: "There are now about 50 electric interurban railway plans in various stages of progress in the South, some to be completed within the next few months. The latter include the Washington, Annapolis & Baltimore Electric Railway, 40 miles; Charleston & Sumnerville Electric Railway, 22 miles; Fairmont & Clarksburg Traction Company, 25 miles; Richmond & Chesapeake Bay Electric Railway, 15 miles, besides extensions of other roads. Construction has begun in Texas on the Texas Traction Company, from Dallas to Sherman, 60 miles, while the same parties are soon to begin work on the Central Texas Traction Company, from Dallas to Corsicana, 65 miles. In Georgia the Atlanta, Griffin & Macon Electric Railway, 86 miles, and the Macon, Americus & Albany Electric Railway, 90 miles, will make 176 miles practically continuous. Another line which will doubtless be built the coming summer is between Houston and Galveston, Texas. The South Carolina Public Service Corporation, just chartered, is to build about 525 miles of electric railways connecting many important points in South Carolina and reaching to Augusta, Ga."

OHIO ELECTRIC LIGHT ASSOCIATION.—At its recent meeting the executive committee selected Toledo, Ohio, as the place for the next convention, and fixed the time as August 20, 21 and 22, 1907. The committee also laid out the plan of the work for the thirteenth annual convention. The plan of having a number of papers on each topic will be followed again this year, and all papers presented will be by central station men. Among the subjects to be covered will be high-efficiency lighting units, central station records and accounting, cost determinations, heating and cooking devices, station experience with magnetite or luminous arc lamps, factory lighting, ways to meet and overcome competition in natural gas, gasoline and other methods in lighting, helps for solicitors, etc. The committee also decided to make a determined effort to increase the membership of the association. Mr. D. L. Gaskill, of Greenville, Ohio, is the secretary of the association. This association has just issued in bound form the proceedings of its twelfth annual meeting. The volume is a handsome and interesting one of nearly 250 pages and the papers and discussions deal with a large variety of important topics. The papers were printed or abstracted in our columns at the time of the meeting. The subjects discussed include co-operative developments, meters, new lamps, best methods of increasing business, legislation, confiscation of coal, day load, portable lamps and chandeliers and other topics of vital interest to central stations. This association is one of the most active of the territorial bodies representing the illuminating interests and its work is always valuable and effective.

NEW STATE CAPITOL AT HARRISBURG, PA.

Lighting of the State Capitol at Harrisburg, Pa.

IN her new $13,000,000 capitol at Harrisburg the Commonwealth of Pennsylvania has erected to herself a monument commensurate with her wealth, pre-eminent in architectural beauty, and accredited the most magnificent state structure in the country. The building, which is classic in design, stands on an eminence known as Capitol Hill, and faces the Susquehanna River. It is built of monumental granite and is 520 ft. long, 254 ft. wide through the center and from the ground to the top of the statue on the dome is 272 ft. high. Ordinarily speaking, the capitol is a five-story structure with a basement having three floor levels. The floors above the basement are known as the first floor; the entresol or mezzanine, in certain parts of the building between the first and second; the second floor, the third floor and the fourth floor. The second floor is the main one of the building. Here is situated in the north connecting wing, the Senate chamber; in the south connecting wing, the House of Representatives, and adjoining the latter in the south wing the executive chambers of the governor; while in the west wing is a suite of rooms forming the official quarters of the lieutenant governor. Both the halls of the coordinate branches of the government extend upward through the third and fourth floors. A feature of the latter floor, which otherwise is sub-divided into departmental offices is the space devoted to the supreme court in the east wing.

Through these successive floors the central rotunda has been carried up, its stairway mounting as far as the second floor to the main gallery from which are monumental entrances to the Senate and House of Representatives. Otherwise the function of the rotunda is purely decorative, forming a sort of focus to the whole design, over which is mounted the dome. The housing of the various departments necessitated the cutting up of the floors into a great number of rooms and for obvious reasons these follow around the outer walls of the building. This arrangement of necessity obliges the connecting corridors to be in the center of the various wings, and they are, therefore, deprived of direct outside light.

At the main entrance outside the porch are two monumental bronze standards each containing 24 incandescent lamps enclosed in cut glass globes. Hanging within the porch are three massive lanterns of bronze each containing sixteen 16-cp incandescent lamps. The design of these lanterns is similar to that shown in Fig. 1. The lanterns are fitted with cut glass in which is graven the emblematic keystone. In the vestibule and corridors leading from the main entrance are also lan-

FIG. 1.—STANDARDS AND LANTERN IN ROTUNDA.

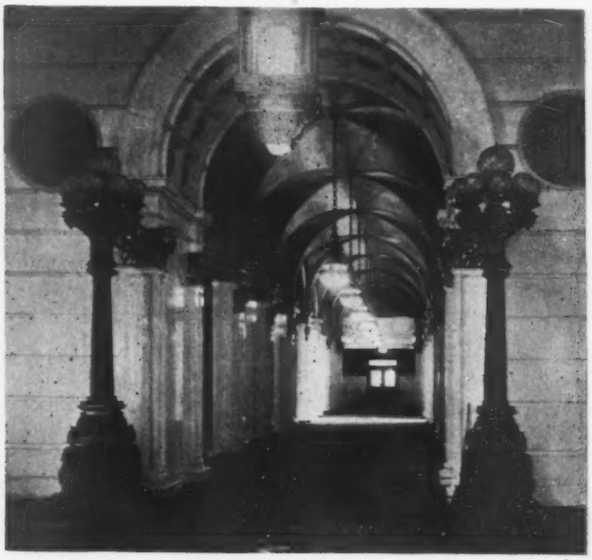


FIG. 2.—CORRIDOR LEADING FROM ROTUNDA.

terns of the same size and design. These are hung from the vaulted ceiling which is covered with varnished gold. Passing from the vestibule into the rotunda one cannot but admire the vast expanse of marble almost immaculate in its whiteness and extending from the tiled floor to the base of the dome. The corridors also have their walls veneered with polished

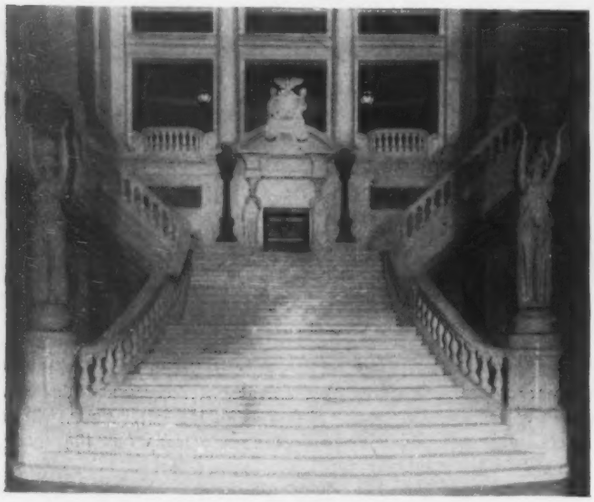


FIG. 3.—GRAND STAIRWAY IN ROTUNDA.

white marble up the arched ceiling. The grand stairway sweeps up and away to the first landing, the marble balustrade winding on around the main balcony and encircling the second floor. Rising from the floor in the angles of the rotunda are magnificent bronze standards with massive bases, tall shafts and branching clusters of electric lamps, each standard having twenty 8-cp lamps. The nine standards around the balustrade of the staircase and balcony have shafts of marble and each has twenty-four lamps mounted at the top, as shown in Fig. 4. Each of the other six standards of bronze has also twenty-four lamps, and in front of the lieutenant governor's suite are two lanterns similar to those in the vestibule. In addition to the standards at the entrances to the corridors massive lanterns are also hung, one at either end. In all there are sixteen of these massive lanterns hanging in various parts of the building. Each of the winged statues on the newels holds a beaded glass sphere in which are twenty-four 8-cp incandescent lamps.

Above the level of the capitals a cornice travels around the square of the rotunda and above this cornice from pier to pier spring four deeply recessed arches enclosing a square area. Upon this rests the dome, the transition from a square to a circular plan being made by so-called pedentives. The central circles of the pendentives and the lunette-shaped spaces within the intervening arches are to be filled with mural paintings. In order that these may be seen to advantage a row of incandescent lamps hidden behind reflectors is placed in the base of these arches. The other clear-bulb incandescent lamps around the cornice at this level are not hidden behind reflectors and while they are not visible from the floor of the rotunda they are visible from the balcony of the fourth floor from which the paintings can be seen to best advantage, and take away from the effect.

The circle into which the pendentives have gathered the square is crowned with a second cornice around the top of which runs a gallery for visitors from which is afforded a superb view of the spacious vistas below and in the dome above. Around this gallery set in a troughed reflector is a row of incandescent lamps arranged to illuminate the dome above. The drum of the latter is constructed of sixteen pairs of pilasters separating as many windows, the whole being covered with a third cornice for the support of the dome itself. Between the leaded windows on the interior and the outer windows of the dome are placed twenty-four lamps, and above the upper cornice and again in the cupola are rows of incandescent lamps. There are in all five rows of lamps which illuminate the dome requiring in all about fifteen hundred 16-cp incandescent lamps. The lighting of the dome is all that could be desired except in the case of the amber-hued windows where the illumination is open to criticism. In the latter case the lamps are arranged so that the windows are not evenly illuminated, the illumination being brighter around the edge than in the center.

The lighting of the rotunda, though not brilliant, is satisfactory. The walls, stairway and decorations being in pure white marble, the factor of reflection is large. All of the lamps are enclosed in cut glass globes and since these are cut with no regard whatever to distribution of light the factor of absorption must be very great. There is, however, an abundance of lamps, so that while the efficiency of the arrangement may be very low the general effect is quite pleasing. From no point except on the fourth gallery where the bare lamps on a part of the cornice are visible, is the illumination trying on the eye even though one were looking down upon all the standards. The cut glass is so heavy that not a single lamp is distinguishable. The main floor, unfortunately, is covered with a dull red tiling of mediaeval design resembling more a roadway than a floor, so that in some places this militates against good results in illumination.

The main corridors extending north and south from the rotunda communicate with the extreme wings. As noted elsewhere these do not receive direct outside light so that artificial illumination must be had at all times. The walls are veneered with white marble up to the arched ceiling and the fixtures are hung from chains as shown in Fig. 2. Each fixture contains six 8-cp lamps, and the individual fixtures are spaced about 18 ft. apart. The illumination of these corridors is most un-

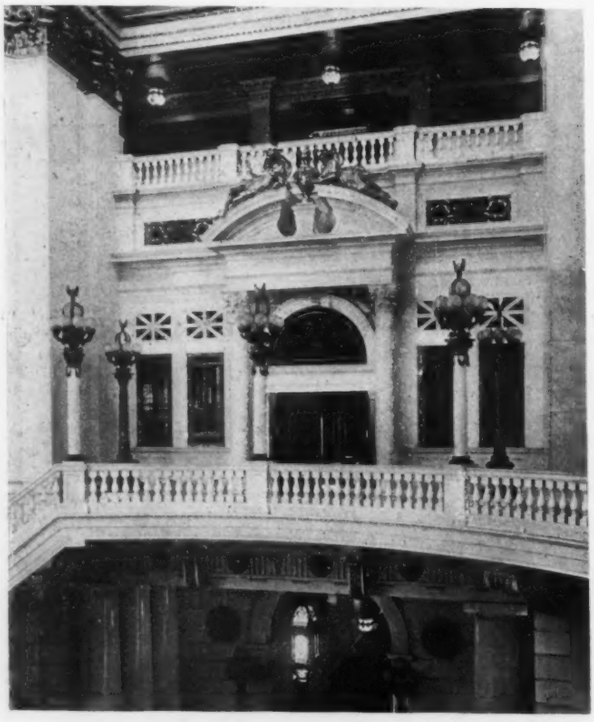


FIG. 4.—MAIN BALCONY OF ROTUNDA.

satisfactory. In both corridors the vaultings of the ceilings leave a series of seven lunette-shaped spaces at each side. These are filled with mural paintings representing the change which has passed over the physical aspect of Pennsylvania in the course of its industrial and mechanical development, and in the south corridor with mural paintings commemorating vari-

ous religious sects that emigrated to Pennsylvania in the early days. The bronze work of the fixtures is so heavy and the cut glass so thick that very little light escapes to illuminate the corridors, and so far as the paintings are concerned, these masterpieces costing many thousands of dollars are simply lost. Were the glass of the fixtures cut so as to give some kind of distribution and were the floor any other than dull red tiling, better results might be obtained. As it stands to-day this is the most unsatisfactory example of illumination in the building. The circuits in all the corridors are arranged so that one lamp is left burning in each fixture all night.

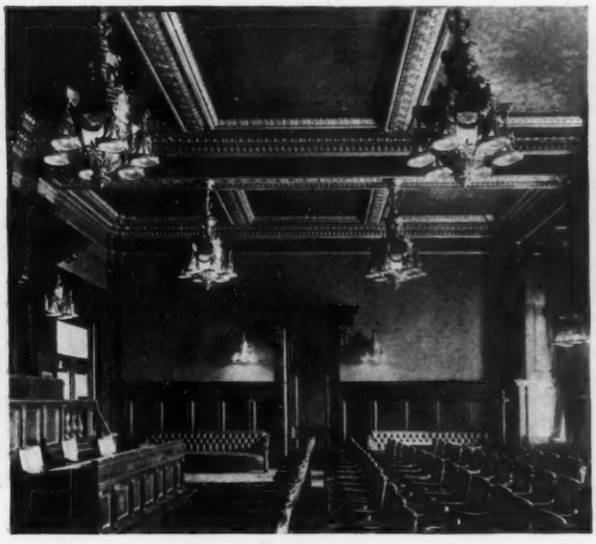


FIG. 5.—SENATE CAUCUS ROOM.

Passing from the corridors, the lighting of individual rooms calls for some mention. In the Senate caucus room the color scheme is dark green and gold, the furnishings being in rich dark mahogany. Ordinarily this room receives light from the outside. Artificial illumination is provided by four electroliers of ornate design hanging from the ceiling, each electrolier containing twelve 16-cp lamps, and seven brackets, each containing three 16-cp lamps. These are disposed as shown in Fig. 5. Little can be said about the illumination of this room, the general effect being good. The House caucus room is larger than that of the Senate and is furnished also with mahogany. The color scheme, however, is blue, buff and gold. The artificial lighting is supplied from four electroliers hung as in the Senate caucus room and containing as many lamps. Disposed around the walls are seven brackets containing three lamps each. The general effect in this room is not so good as that in the Senate caucus room, the fixtures being somewhat different and being fitted with a clearer glass through which from certain portions of the room the lamps are visible. The Senate library and House library adjoin their respective caucus rooms and the lighting scheme is similar in both. There are two electroliers of the design shown in Fig. 7, each containing twelve 16-cp lamps, and four side brackets each containing two lamps. In addition there are single lamp fixtures for the book cases.

FIG. 7.—SENATE LIBRARY.

FIG. 6.—STATE TREASURY DEPARTMENT.

FIG. 8.—ELECTROLIER IN STATE TREASURER'S OFFICE.

The room of the state treasurer's department is shown in Fig. 6. The color scheme here is maroon and gold, and the

room has an abundance of daylight streaming through a series of six large windows. There are eleven electroliers hanging from the ceiling, each containing six lamps; five side brackets each containing three lamps, and each of the pedestals of the screen is surmounted by a single lamp in a cut glass sphere. The globes on the brackets and chandeliers are of very heavy opaline glass having a large factor of absorption, so that the efficiency of the lighting scheme is low, albeit the lighting itself is satisfactory.

The governor's suite in the south wing has a decorative treatment in English renaissance. The decorative motive of the reception room is repeated in the secretary's office and with more elaborateness in the governor's room. The reception room

FIG. 9.—STANDARD IN GOVERNOR'S RECEPTION ROOM.

is the largest of these rooms, being 72 ft. long and 27 ft. wide. The color scheme is of dark oak paneling to a height of nine feet. The decoration compared with that of the governor's room is very simple. It consists of a series of pilasters supporting a cornice above which are spaces occupied by paintings treating in series "The Foundation of the State of the Liberty Spiritual." The room is lighted by three chandeliers, each containing 26 lamps and four magnificent pedestals, each containing 24 lamps. The lighting of the room so far as the pictures around the wall are concerned is faulty. It borders on the ridiculous to cover the walls with expensive paintings and then provide no means for their proper illumination. The pictures in the corners are hidden, those abreast the chandeliers receive some light, while those between are partially in shadow.

The room of the governor's secretary is lighted by a beaded glass electrolier containing eight 16-cp lamps and by two beaded glass side brackets each containing two lamps. The brackets are very pretty, but they are only placed about 5 ft. from the floor, just high enough to miss the head of an average sized person sitting on a chair. The governor's room is signalized especially by its superb panelling executed in dark quartered oak above which are spaces filled with portraits of governors. The fixtures, of which there are two, are of gilded bronze and crystal glass suspended from the ceiling. Behind the beaded glass are twelve 16-cp lamps and outside are 18 miniature frosted-bulb lamps arranged as shown in Fig. 12. There

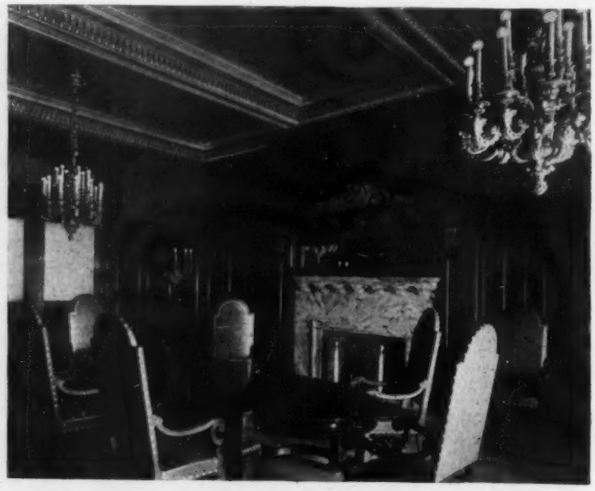


FIG. 10.—LIEUTENANT-GOVERNOR'S RECEPTION ROOM.

are, in addition, four side brackets each containing two lamps and like those in the secretary's room these are hung quite low, as may be seen in the illustration.

The lieutenant governor's suite is in the west wing and consists of three rooms. The main room or reception room is shown in Fig. 10. The illumination here is good, there being two chandeliers each fitted with eighteen 8-cp frosted-bulb lamps, and four brackets fitted with three lamps each. The

FIG. 11.—CORNER OF GOVERNOR'S RECEPTION ROOM.

ladies' parlor intended for women who come to intercede for prisoners condemned to death, is furnished in elegant style. The walls are of a green hue splashed with buff and are divided into panels intended for tapestries. The ceiling contains a circular painting of Venus and two Loves. There are two

chandeliers of ornate design each fitted with twelve lamps and two brackets each containing three lamps, provided for this room. The lieutenant governor's private office is fitted somewhat like the ladies' reception room with the exception that there are three brackets each containing two lamps.

The supreme court room, a view of which is shown in Fig.

FIG. 12.—GOVERNOR'S PRIVATE OFFICE.

13 is on the fourth floor in the east wing. The room is 72 ft. long by 42 ft. wide, and is surmounted in the center by a glass dome in the roof through which daylight enters. The walls to a height of nine feet are sheathed with a wainscot of mahogany. The panel spaces are at present tinted, but will eventually hold pai...gs representing the general development of law from unwritten tradition to the codified system. The fixtures are quite elaborate. There are four pedestals, each containing 24 lamps, and four chandeliers arranged with six clusters, each of which contains 9 miniature frosted-bulb lamps. In the upper part or dome of the fixture are six 16-cp lamps, and at the extreme top of the fixture are twelve clear-bulb incandescent lamps. No advantage is taken of the sky-light for indirect illumination of the room, but the general illumination is fair.

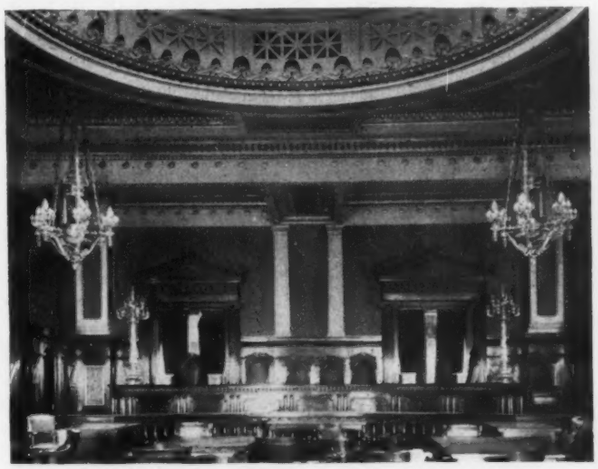


FIG. 13.—SUPREME COURT ROOM.

The Senate chamber is 95 ft. wide and 80 ft. long, of which latter 29 ft. is given to the visitors' gallery, which is set back behind five arches. The decorations in this room must be seen to be appreciated. The color scheme is dark green relieved with lighter shades of green and gilding. The color scheme is rich and reserved and is patterned after the choir gallery of St. John Lateran in Rome. Beautiful painted windows so placed as to receive direct sunlight at times serve to enhance the decorative effect. The chamber receives light from large windows in the east and west sides. In the cove the ornament and gilding are most profuse, the feeling of sumptuousness being carried through to the upper part of the chamber by the candelabra. The ceiling is divided into coffers by decorated beams from the intersection of which hang massive candelabra of gilded bronze, each of them bearing six main brackets as well as surrounding wreaths and clusters of small bulbs. In all there are 70 lamps in each of these six candelabra, which weigh nearly two tons apiece. To carry this immense weight specially

FIG. 14.—STANDARD IN SENATE.

constructed trusses were inserted in the framework of the roof and from these are suspended strong hangers to each of which one of the chandeliers is attached. There are in addition four magnificent pedestals each containing 39 lamps in cut glass spheres and fourteen side brackets each containing nine lamps also housed in cut glass. The illumination of this room is very pleasing, with the exception of the clear-bulb lamps at the bottom of the massive candelabra which should be of frosted glass so as not to be so distressing to the eye of a visitor in the gallery.

The House of Representatives is greater in size and superior in ornateness than the Senate. The color scheme is a deep-toned blue with the prevailing hues of cream, buff and gold. Painted windows also form a feature of the decorated ceiling in this room. The main ceiling is supported on arched ribs springing from the entablature above each of the pairs of columns and is divided by richly wrought and gilded beams into a geometric arrangement of coffered spaces, the central feature being a circle 24 ft. in diameter which is to contain a painting. The subordinate spaces in the ceiling are colored a deep blue

and overlaid with gilded Renaissance ornament; while from the points of intersection of the beams are suspended candelabra

FIG. 15.—MASSIVE ELECTROLIERS IN HOUSE OF REPRESENTATIVES.

more massive and ornate than those in the Senate chamber. These candelabra are of two sizes, one comparatively small and the other very large. They are not swung on chains as are those in the Senate chamber, but are compact in form, elaborated with decorative detail until they suggest enormous bouquets illuminated with countless blossoms. As designed by the architect they are intended to gather into concentrated masses the richness that is distributed around them in Renaissance ornament and Corinthian details and preserve some of the architectural feeling. The provisions made in the roof for supporting these massive bronze candelabra are the same as noted for those in the Senate.

Each of the four great chandeliers contains 140 lamps, the smaller chandeliers contain 70 lamps and each of the four magnificent pedestals in each corner of the room contains 24 lamps. There are in addition eighteen side brackets, each containing 11 lamps, and four chandeliers in the visitors' gallery, each containing 12 lamps, eight of which are on the outside. The lighting of this room is faulty or satisfactory according to the position of the observer. The majority of the lamps in the immense candelabra are arranged on the outside of the fixtures in the festoons and have clear glass bulbs. Viewed from the visitors' gallery the effect is blinding; from the floor of the house the lamps are too high to come in the line of vision. The lamps in the brackets and those on the pedestals are enclosed in heavy cut glass spheres so that the brightness is considerably toned down and not distressing to the eye. Such gorgeous interior fittings and decorations are probably not to be found in any other building in the country.

The fixtures,—and we approach this subject with a sort of reverential awe, as these famous adjuncts will find a place in history,—were cast by a Philadelphia concern especially formed for that purpose and which, fearing to outlive its usefulness, most opportunely dissolved as soon as the fixtures were delivered. They were designed by the architect who slavishly adhered to the sumptuousness of mediaeval design as exemplified in the Pantheon at Rome and St. Mark's in Venice. They were designed on a very high key and were paid for by the pound, the rate being $5 per pound. This brought the total cost of

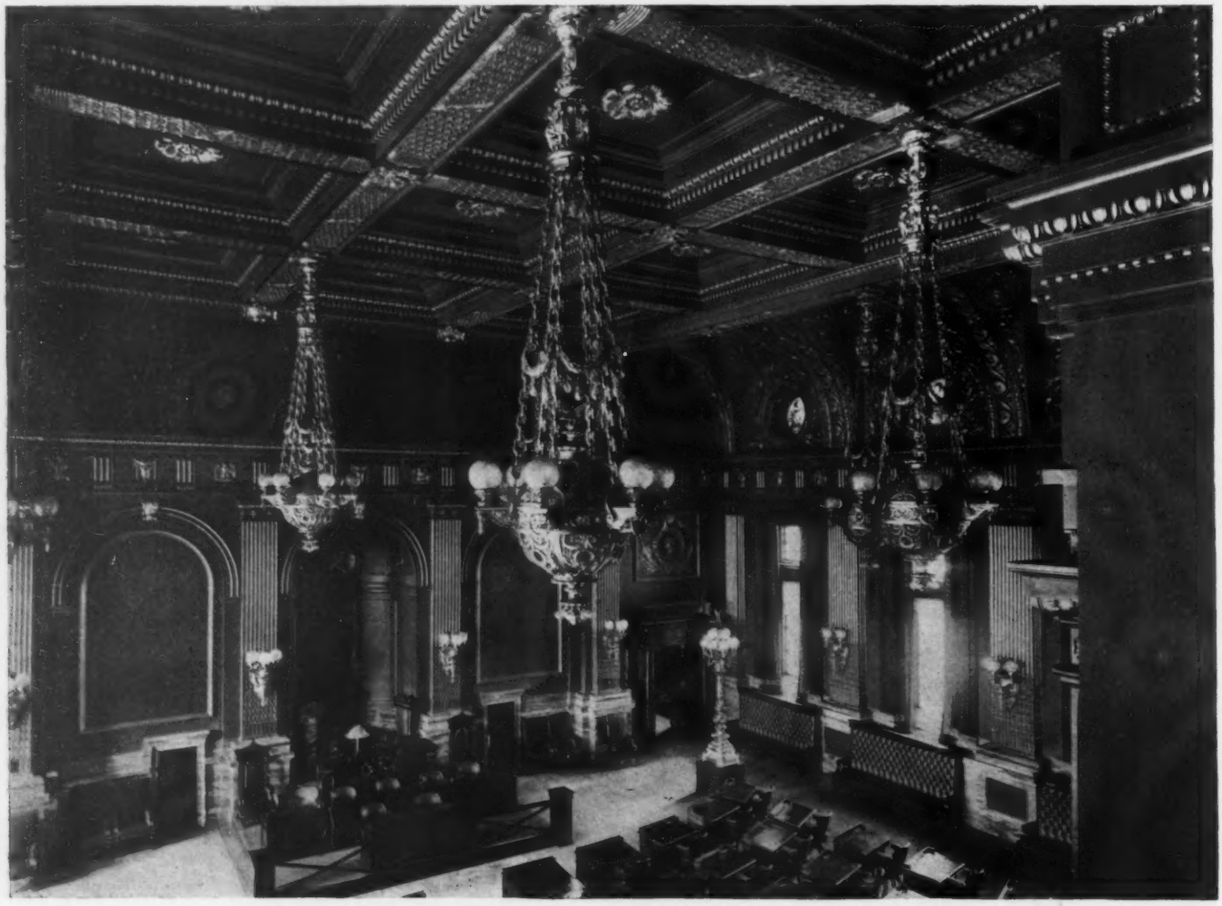


FIG. 16.—THE SENATE CHAMBER, STATE CAPITOL, HARRISBURG.

fixtures in the building to $2,000,000; the building costing in the white $4,000,000. There is no question as to the excellence of workmanship in the fixtures and standards, which are specimens of art; but there is an excess of ornamentation. For purely decorative purposes the effect produced is obtained at too great a cost; as chandeliers for holding lamps intended to illuminate the building the fixtures are faulty, since they are so ponderous that they obscure most of the light. There is a shadow beneath almost every lantern, chandelier and pedestal in the building, and in cases already mentioned valuable paintings are hidden almost from view. No better proof of the contention that the metal chandelier is a relic of older system of lighting is to be found. The chandeliers in the Senate, for instance, cost about $20,000 each; there are six of these provided at a cost of about $120,000 and they hold in all 420 incandescent lamps. The fixtures in the House are doubtless much heavier and hence cost more. There is also a sort of passage from the ridiculous to the sublime in the character of the electric

FIG. 17.—HOUSE OF REPRESENTATIVES IN STATE CAPITOL, HARRISBURG.

work. To anyone taking the trouble to climb to the cupola surmounting the dome the element of cheapness will be apparent, for the wiring for the cove lighting in the dome from the lowest cornice up is enclosed in cheap wooden molding which could hardly be termed first-class construction in a fireproof building. Compare this straining at a gnat with the swallowing of a camel in the ordinary toilet room fixtures costing $150 each. Moreover it is worthy of note that the cheapest construction has resulted in the best illumination, while the most expensive has resulted in the worst.

The electricity for illumination is supplied from an isolated plant in the basement consisting of four Harrisburg engines of 225-hp, direct-connected to 150-kw, 220-volt C. & C. generators. There are approximately 12,000 lamps in circuit, 2,000 of which are of 8 cp. The building is wired on the two-wire system, 220-volt lamps being used.

Generating Station of the Edison Electric Illuminating Company of Altoona, Pa.

The Edison Electric Illuminating Company, of Altoona, Pa., is the older of the two electric light companies now operating in that city. The company maintains in addition to its station on Union Avenue and Eighteenth street, a display room and office on Eleventh Avenue and Twelfth Street, a block above the Pennsylvania Railroad station. The electrical equipment like that of many of the old Edison stations throughout the country is a mixture of old and new, the former still giving good service in competition with more modern apparatus and paying almost as large a return on the investment. As long as this obtains there is, of course, no object in scrapping this sturdy old machinery; but the additional equipment necessary to supply growing demands will be of the latest type and thus by a process of elimination will the station become modernized.

The present equipment consists of five Ball & Wood engines, two of which are direct-connected to four 75-kw direct-current generators, two are belt-connected to two 500-light Brush arc machines, and one is direct-connected to two 200-kw direct-current generators. There are also one McIntosh & Seymour cross-compound vertical engine direct-connected to a 400-kw, 275-volt generator, one engine of the same make but horizontal, direct-connected to a 300-kw, three-phase alternator, one Green (Altoona) engine belted to a 100-kw pair of 125-volt generators and a 100-kw, three-phase, motor-driven generator delivering direct-current at a potential of 220 volts, the potential of the alternating current being 2,100 volts. The boiler equipment comprises 500 hp in Stirling water-tube boilers, four 250-hp internally-fired Edgemoor boilers, one 350-hp Heine water-tube boiler and one 500-hp Edgemoor water-tube boiler. These are all fired with bituminous run-of-mine coal costing

in the neighborhood of $1.50 per ton. Feed-water is supplied to the boilers by three Hughes plunger pumps.

The chief difficulty in central station operation in Altoona is the lack of water. The feed-water which is purchased and also pumped from deep wells is stored in an underground cistern in front of the boilers. The cistern has a capacity of 102,000 gal. The water is forced into the cistern through the exhaust steam from the engines. In this way a partial vacuum results which heretofore has served as a partial condenser, the inlet and outlet capacity just fitting the load. This, however, no longer holds true. The exhaust steam is passed through separators on the exhaust line made especially to fit the conditions so that oil does not find its way into the cistern. The cistern has recently been enlarged so that a greater portion of the exhaust steam could be passed to it. It now has a capacity for 48 hours supply. Fuel is brought in front of the boiler room on a trestle connected with the Pennsylvania Railroad tracks.

There are three switchboards in use, a direct-current board of black slate, an alternating-current board of marble and a Brush arc board. The distribution system is all overhead, and all lines leaving the switchboards pass under the floor into a brick tower, passing out thence in three directions. The station is located at about 2,200 ft. from the electrical center on a site an acre and a half in extent. A large portion of the ground is used for pole storage and for a trestle and coal bins,

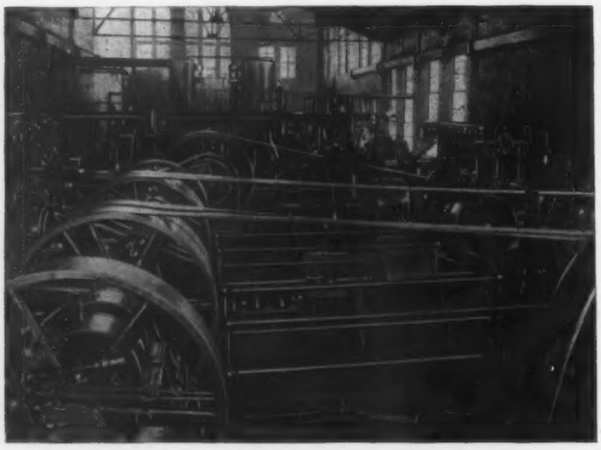


FIG. 1.—DYNAMO ROOM OF THE ALTOONA EDISON COMPANY.

the latter having a storage capacity for three months' supply.

The station load is divided in the proportion of 2 to 9, that is, 9/11 of the load is direct current and 2/11 is alternating current. The energy is sold at the rate of 8 cents per kw-hour for the first 26 hours of connected load per month and after that at the rate of 4 cents per kw-hour. Motors and lamps are charged alike and cooking utensils if used at all come under the 4-cent rate. The minimum bill is $1 per month, and all customers are supplied through meter. Energy is also sold for electrolytic purposes and for charging telegraph lines; the Western Union, Postal and Pennsylvania Railroad companies taking current directly at 110 and 220 volts through lamp resistance instead of from battery. In this way the Philadelphia Edison, Harrisburg Edison, Altoona Edison and Allegheny County Light Company of Pittsburg are tied together electrically through the telegraph lines.

Alternating-current and direct-current day circuits are maintained and motors are fed from both. The alternating-current load is greatest at about 7 o'clock at night and does not change much during the month. The direct-current load changes in peak from 6 to 8 o'clock during one week each month, and the demand at the peak at this time changes about 22 per cent. Altoona is what may be termed a railroad town, being built around the great shops of the Pennsylvania Railroad Company. The employees of the railroad are paid once a month. Various departments are paid on different days so that the pay-day period extends over a week. During this week the storekeepers who close their shops at all other times at 6 o'clock keep them open until 10 o'clock, which accounts for the shifting of the peak during this week and its increase.

The Edison company has a number of refrigerating machines connected with its system. At the suggestion of the electric light company the makers of these refrigerating machines placed a clutch on the shaft and a heavy fly-wheel for use in starting. When the motor is up to speed the clutch is thrown in and the pump started. This reduces the energy consumption of the motor at starting and makes it possible to install a smaller motor and at the same time obtain much better service. It has been found by the electric light company that the refrigerating machines require 4½ hp per ton capacity in starting and 1¼ hp per ton capacity to operate it afterwards; so that on a 6-ton machine 27 hp is required in starting. The company, by means of the changes above noted, placed a 10-hp motor on the refrigerating machine and set the circuit breaker to blow at a current equivalent to 15-hp, and only once has the circuit breaker been known to open.

Two solicitors are employed to increase the lighting load and one solicitor is employed on heating and cooking devices. No literature to speak of is distributed and the solicitors make more of a house-to-house canvass. The company makes a display of various devices in its office on Twelfth Street, and while it does not keep any supplies it sells motors. Lamps are renewed free of charge and pains are taken to see that every installation is satisfactory. No signs are sold by the company or put out on monthly payments. Customers purchase their own electric signs and these are carried at the same rate as ordinary lighting. A number of electric flat irons are in service which were first placed on trial and afterward sold by the company at cost. A feature worthy of note is that any complaint received up to 9 o'clock at night is attended to that night. The company has a contract with the city of Altoona for 400 enclosed arc lamps at the rate of $50 per year, and is obliged to supply the fire houses of the city with electricity for lighting free of charge. About 39,000 incandescent lamps are connected to the system. Mr. E. B. Greene is the superintendent of the company.

Car Lighting.

BY J. R. CRAVATH AND V. R. LANSINGH.

The efficient electric lighting of steam railroad cars is a matter which has received but little of the attention which its importance deserves. Steam railroad cars, up to present writing, have been almost invariably equipped without any reference to delivering the most useful illumination for the money expended and this, too, in spite of the fact that frequently the source of current supply is a storage battery with a limited capacity. If more attention were paid to the efficiency after the current was delivered to the lamp, it would materially help out the amount of useful service that could be obtained from a given size of storage battery, as cars could be well lighted with less electrical energy. In the case of electric cars, it is not so much the question of efficiency as of general effect and good illumination without blinding glare.

Fig. 1 shows the interior of a private electric car which can be taken up for discussion to illustrate some of the points which will be brought out. This car, in addition to having an ample supply of incandescent lamps has also an arc lamp, as seen, which is entirely out of place in a car of this kind and will be left out of account. The incandescent lighting is accomplished by a row of frosted bulb incandescent lamps along each side of the car. For an electric car where efficiency is no object the arrangement is fairly good. The frosted bulbs very much reduce the glare which would be received from a row of clear bulb lamps so located and there is no particular need of increasing the efficiency by the use of reflectors, although the shading and diffusing which would be accomplished by an opal or prismatic reflector would be very desirable. If this were a steam rail-

road car drawing its electric lighting current in whole or in part from a storage battery, the economical aspect of the case would be quite different. These lamps should then be equipped with reflectors, because of the greatly increased amount of light that could then be delivered at the seats, as well as for

FIG. 1.—INTERIOR OF PRIVATE ELECTRIC CAR.

diffusing and shading reasons. This location of the lamps (which would bring them over the seats of an ordinary railroad coach) is excellent. The reflector selected should be one which would come down well over the lamp so as to diffuse the light and prevent it from blinding anyone looking the length of the car.* Opaque metal reflectors would manifestly be out of place in car lighting so that the choice lies between opal and prismatic glass if we leave out of account reflectors of sand blasted glass which do not modify the distribution of light sufficiently for this particular purpose. Opal reflectors have the advantage of being smooth and so more easily cleaned than prismatic reflectors. They have a disadvantage strongly urged by some railroad men who have had experience with them that they show very badly the dirt which collects upon them between cleanings. Prismatic reflectors, while not so easily cleaned, do not look as badly when dirty as opal, because the dirt collects in the bottom of the prisms where it is not noticeable. After all, the cleaning of a prismatic reflector is not very difficult if the cleaner is provided with a stiff brush and brushes lengthwise of the prisms.

No ordinary flimsy shade holder should be used for holding reflectors in car lighting. A cast brass or bronze holder fitting over the socket as do the bronze husks shown in Fig. 2 should be used. This holder is fastened directly to the ceiling independently of the socket so that the weight of the reflector will not pull the socket to pieces. On Pullman cars the berths interfere with such a location of lamps and those for the general lighting of the car must be placed in the center, being usually grouped around the gas light. With lamps so placed, reflectors giving a maximum candlepower at about 30 to 45 degrees from the vertical would be best, assuming the lamps to be placed vertical. (See the articles before referred to.) If placed at angles radiating from the gas fixture, more concentrating reflectors should be used, and the lamps should be pointed at the seats, not up and down the aisle.

Some day coaches are provided with lamps on brackets located high between each window. In this case also, deep reflectors which cover the lamp and give their maximum candlepower from 30 to 45 degrees from the vertical should be used if the lamps are placed vertical. With such bracket lamps considerable light must necessarily be lost because of the failure of the woodwork to reflect part of the light which goes in that direction.

In the lighting of dining cars, the principal thing is to provide a lamp at each table so arranged and so equipped with reflectors as to concentrate nearly all of its light on the white table cloth. With well lighted tables, the balance of the car will take care of itself. This table lighting can be accomplished by artistic brackets extending but a short distance from the side of the car, over each table and with lamps pointed down toward the table top. If desired, the subdued effect in table lighting so much sought for recently can be obtained by proper shading of the light, always remembering, however, that the concentrated beam of light from the reflector on to the top of the table must not be interfered with, however much the light may be shaded to the eyes of a person looking the length of the car. It goes without saying that all brackets and other fixtures used in car lighting must be short and substantial.

Fig. 2 is a remarkable example of the small difference there may be between the right and wrong way of lighting a dining car. In this illustration there is a two-lamp bracket over each table. This bracket, however, instead of being properly equipped with a lamp in a deep reflector which would concentrate the light on the table and shade it from the eyes of persons seated some distance away, has two lamps in reflectors giving a very wide distribution and these lamps are pointed away from the tables. The result is that only a very small per cent of the light of the lamp is directed on the table top. The reflectors do not act to diffuse or shade the light and the whole arrangement is much less efficient and much more trying on the eyes than it would be with the very small changes mentioned. The gas lighting in this car is by means of the standard Pintsch gas fixtures fastened to the center of the car deck. This is about the only feasible arrangement for gas lighting in a car and is less trying on the eyes than some of the attempts to place gas or other lamps along the sides of the car. Electric

FIG. 2.—ARRANGEMENT OF LAMPS IN DINING-CAR.

lamps should be placed low along the sides of a car only when thoroughly shaded.

In the case of berth lamps in sleeping car, these lamps should always be shaded in such a way that persons facing them will not have the light shining in their eyes. This can be done by proper designing of fixtures. On some electrically lighted sleep-

* See series of articles by the authors on "Reflectors, Shades and Globes," ELECTRICAL WORLD AND ENGINEER, Nov. 25, Dec. 2, 9, 16 and 23, 1905.

ing cars this shading is accomplished very well. On others these berth reading lamps are entirely exposed and are very trying on the eyes of anyone who must face a row of them an entire evening. This is true whether the person is actually looking at the light or not.

Photographs of Electric Discharges.

Some interesting photographic investigations of electrical sparks and discharges have been carried out at Nantes, France, by Dr. Stephane Leduc, as evidenced by the accompanying illustrations of some recent photographs made by this investigator. The effects produced are not unlike those of snow shapes or ice crystals, or those given by the kaleidoscope. The photographs are used as designs for decorative purposes, various patterns being first provided for the general outline, according to whether the design is for wall paper, carpet or rug patterns. The outline of a star, letters, figures or other patterns are placed on a photographically sensitive plate, then metallic oxide, starch or other fine powder is sifted over the sensitive surface of the plate, after which the pattern is taken from the plate, leaving the tracings of the openings on the same. The exposure to the electric discharge is made in a dark room and the sensitive plate is then developed as in the case of ordinary negatives exposed to light in a camera.

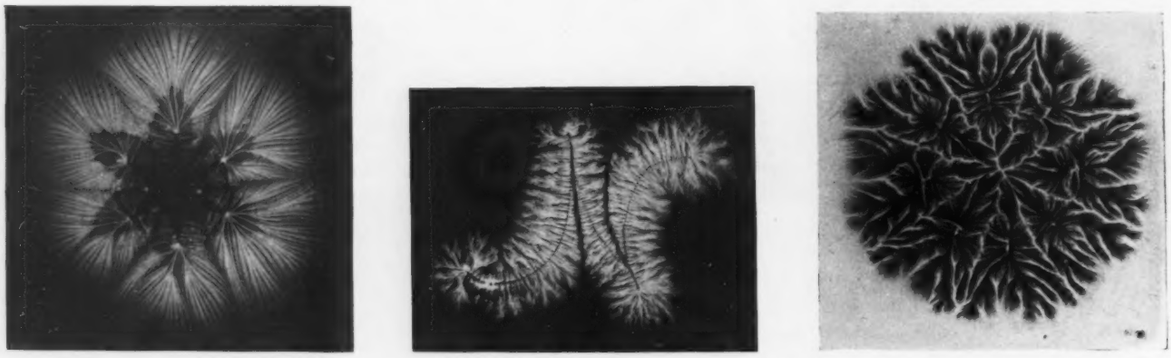
With these electric photographs no camera is required, as the plate with the outline in fine powder is placed on a metal foil, joined to the outer coating of one of the Leyden jars of a frictional machine. The other jar of the static machine has its outer coating connected to a point placed in the middle of the tracing perpendicularly to the sensitive surface. The static machine then has its two poles connected to the inner coatings of each jar respectively, a screen being provided for protecting the surface of the photographic plate from the discharge of sparks at the machine.

As will be noted from the illustrations, unique and interesting photographic prints are obtained from the negatives after development, the designs being varied according to the patterns used, the arrangement of the powder, the strength of current and the form of metallic conductors employed. It is maintained that the tension of the current makes a great difference in the results obtained as does also the temperature and dryness or moisture in the atmosphere.

Some important investigations have been made of electric fields by this photographic process. Images of electric spectra have been obtained by photographing silent discharges of electricity by placing the metallic point and sensitive plate in the same position as when using the ornamental patterns, the plate and point being again connected to the outside metal coatings of the Leyden jars.

By using a single point a photograph of a monopolar field is obtained, two points being employed giving a bipolar field, the photographs produced giving designs somewhat similar to iron filings with magnetic fields. The photographs with unlike poles show lines drawing together and connecting the poles while with poles of the same sign the photograph of the electric discharge resembles the filings outline of two magnetic poles, which are alike, either both positive or both negative.

By employing a number of points multipolar electrical fields are photographed and by placing the points perpendicular to the plate or parallel with the plate many interesting changes are noted in the results. It is necessary to employ plates of the anti-halo type so as to avoid the veil due to the spark in many of these experiments in order to obtain the best results.



Figs. 1, 2 and 3.—Artistic Effects Obtained by Means of Electric Discharges.

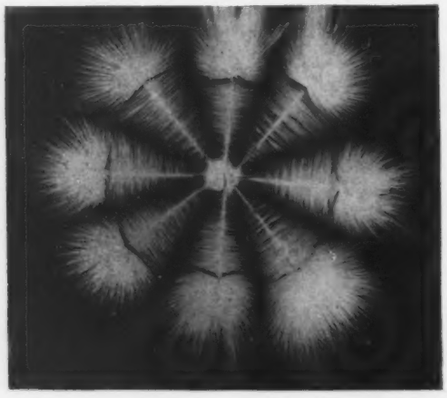


Fig. 4.—Reproduction of Photograph of Electric Discharge.

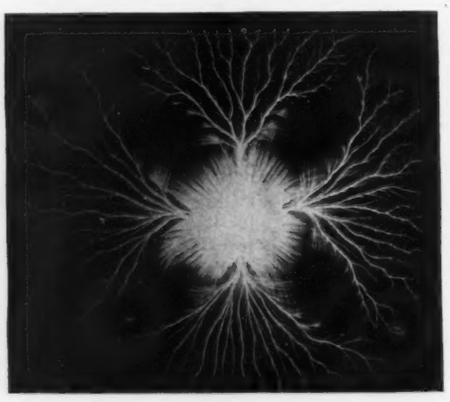


Fig. 5.—Reproduction of Photograph of Electric Discharge.

It is also stated that red oxide of mercury is employed to advantage, the plate being immersed in the compressed oxide while the discharge is taking place. There is also a great difference in the figures produced on the plates if the point is positive and the plate negative, the former connections having been reversed.

Some Advice to Inventors.

BY W. W. DIXON.

It has been estimated that at least 85 per cent of the patents issued from the United States Patent Office possess no commercial value. While this may be an exaggeration, there is no doubt that an immense amount of time and money is annually expended by the ingenious on supposed inventions, which either do not get beyond the application stage in the Patent Office, or if they possess sufficient novelty to warrant the issue of a patent, never bring any returns to the inventor. One reason for this deplorable condition is undoubtedly a lack on the part of the inventor of knowledge of the prior "state of the art" in the branch with which he is dealing, and it is most strongly to be urged that when one thinks he has evolved an inventive idea, the first step should be to determine its relation to the "state of the art."

Few inventors, of course, can in this respect follow in detail the practice of opulent professional inventors and some of the large manufacturing companies, who possess, or have access to, libraries embracing the entire literature of the art and the science concerned in their line of work, including patent publications of foreign countries. They can, however, obtain for a small price from the United States Patent Office, a collection of all the specifications and drawings of United States patents in print (about 6 per cent are usually temporarily out of print), in the class or sub-class to which the invention in mind relates, and no inventor should proceed with an idea before he has availed himself of this inexpensive opportunity for testing its novelty and comparing it with the conception of others in meeting the same or a similar end. Moreover, a glance through such a collection of patents will broaden the vision of the inventor, and even if he finds that his original idea has been already covered, the general knowledge which he will thus acquire relating to the art may suggest a different and better method for attaining the object he has in view. When one in direct contact with a certain line of work finds the need of an improvement, the greatest incentive to an invention is established, and the work of others along similar lines, but with perhaps different objects in view, should be highly instructive, and may lead to a notable and profitable invention not at all conflicting with those inventions which furnished part of the inspiration.

As the Patent Office is not permitted by its rules to act in any manner as an adviser to inventors, letters to that office asking for information in a general way will not receive consideration. The following method is therefore offered as the one to follow in the matter in question:

First, write to the United States Patent Office, Washington, D. C., for the "Classification of Patented Inventions," enclosing a money order for 10 cents in payment.

Second, from the classification given in this publication determine what class or sub-class the invention in mind would come under; sometimes it will be necessary, owing to the indefiniteness of a subject, to select several sub-classes.

Third, then write to the Patent Office, specifying the classes or sub-classes selected and ask the total expense of all the patent specifications to date embraced in the same. The reply will state the number of patents, and the total cost. The cost is 2 cents each, if all the patent publications in a class that are in print are purchased, or 3 cents in the case of sub-classes. If it is intended to purchase the patents concerning which inquiry is made, it will then be merely necessary to forward a postal money order for the amount quoted by the Patent Office; it will be well in the letter ordering the patents, to confine the text, as nearly as possible, to the language of the letter of quotation from the Patent Office. In all this correspondence letters should be limited so far as possible to a sentence, for the introduction of extraneous matter will be useless, and apt to lead to delay.

Only an approximate idea of the number of patents issued since 1789 in each class and sub-class can be obtained from the classification pamphlet above referred to, as this publication is only brought down to 1905, but the Patent Office will, as stated, supply the information to date. As examples chosen from the pamphlet, there were in 1902 85 patents on steam engine indicators of every type and on their engine connections, in five subclasses, the total cost of which would be $2.55. In the class of steam and vacuum pumps there were 247 patents, the cost of the specifications being thus $4.94. On electromagnets for special applications there were 145 patents in a single sub-class, and 13 patents in a sub-class on electrical ore detectors. It may be noted as a curiosity of the classification that while 274 patents had been issued on compound engines from 1789 to 1902, no less than 2,149 patents have been taken out on that will-o'-the-wisp of inventors, the rotary steam engine.

When Inventions are Worth Patenting.

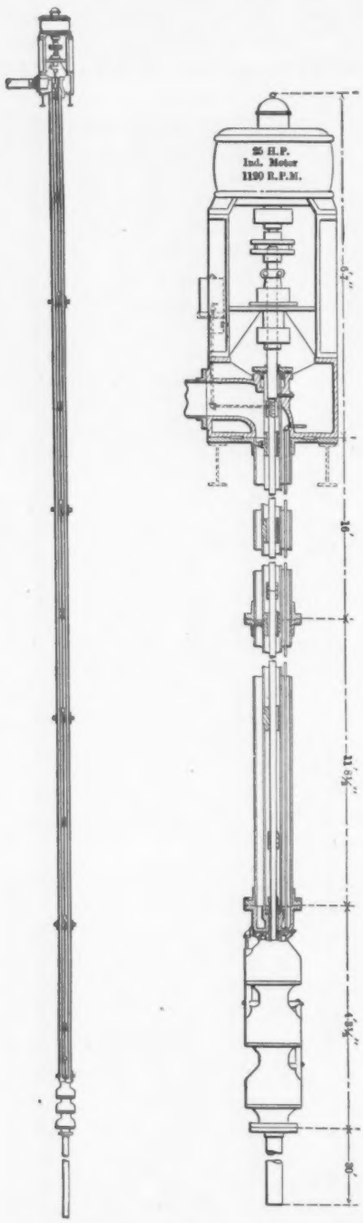
BY FREDERICK A. TOBLER.

The records show that at least 85 per cent of the inventions patented in the United States are of no practical value. This state of affairs would seem to show that American inventors are either lacking in genius, or are deplorably unfamiliar with the needs of the industry, to the advancement of which they apply their talent. Doubtlessly this condition is due to a lack of commercial rather than mechanical insight, and can be readily surmounted if the inventor will but cater to capable outside opinion, and rely less upon his own. Theft of invention is impossible when exposure is general and the invention fully developed. Indeed inventors are too enthusiastic; they rely entirely too much upon their own judgment with regard to the commercial outlook for their inventions, when in fact the mechanical side is properly the limit to their judgment.

Some of the most ingenious mechanisms are of no commercial value and consequently bring nothing to the inventor beyond the satiation of personal conceit. It is easier to abandon a worthless invention before it is patented than after. There seems to be some tie between human nature and a monopoly. There are a number of individual methods which inventors have adopted in order to determine the question, "Is my invention worth patenting?" but to the writer's mind and borne out by actual experience, the method detailed below is one of the best, giving excellent results at a minimum cost.

The very first step to be taken in following up this method is to have a tracing made from the drawing, which will be done by an architect or mechanical draftsman at a cost ranging from $1.00 upward. This accomplished, as many blue prints can be made from time to time as there will be need for. Having made a generous supply of blue prints, a directory containing a list of those engaged in the manufacture of the particular article to which the invention relates should be procured. Directories, or "Buyers' Guides" are issued in almost all branches of industry, and perhaps the simplest way to get just the kind wanted is to address a technical or trade journal for information on the subject, also for a small sum Boyd's City Despatch, 16 Beekman Street, New York, and the Rapid Addressing Machine Co., 79 Dearborn Street, Chicago, are prepared to furnish lists of firms engaged in different lines of business in the United States. The directories or lists give the addresses of all those engaged in the business to which they relate, but the larger firms should not be the first ones to be approached as they are the least apt to give an invention, other than one containing a basic feature, due attention. Moreover, such manufacturers have in their employ a corps of experts, both mechanical and legal, which makes it unsafe to submit for their perusal anything in the undeveloped state. One company in the United States of this character had over 100 skilled experts in its mechanical department and 11 lawyers in its legal department and any invention or idea submitted to one of its offices located anywhere will be forwarded free to the head office for investigation; it would, however, be foolish for any inventor to take advantage of this facility for he would be

merely pitting his idea against the practical skill of a hundred or more experts. The chief aim of this ultra charitable arrangement is probably merely to gather food to stimulate the developing powers of its own experts, though possibly, also with a view to the purchase of good patents provided their school of experts, mechanical and legal, cannot do better. The smaller manufacturers have no department of this kind, and will be apt to look into an invention submitted and form an opinion based upon its probable merits with a view to its purchase. The smaller manufacturers are always on the alert for something that will enable them to enter more successfully into competition with the larger firms. Generally a patent is the most likely means to accomplish their aim in this regard, and any-



FIGS. 1 AND 2.—DETAILS OF DEEP-WELL PUMP AT LA GRANGE.

thing in their line, in the shape of a new invention, is always a very tempting bait. Then again, a well-composed letter and other enclosures necessary to present the subject in a proper and attractive light are all-important, as the first impression is usually a strong factor in a deal of this kind. In the first place, the tracing from which the blue prints are made should be well drawn, and the letter accompanying the prints should be concise and, if possible, typewritten. Time is very important to men engaged in successful businesses and in consequence many poorly-written, though important, letters go to the waste basket virtually unread. The more blue prints and letters sent out the better, and an inventor can, as a rule, rest assured that if those to whom the subject should appeal show no interest in his invention, it is probably worthless from the commercial standpoint, and the idea of patenting it should be abandoned.

Even though an invention thus tested should be a good one, it must not be expected that all those addressed will want to hold rights under the invention, but from the general tone of the answers received, the likely commercial value of an invention can usually be determined. Companies particularly interested in the patent situation usually only buy those involving a basic feature or claim, as they keep experts who can get around almost any combination patent should it be to their interest to do so; therefore, in the ordinary case but little encouragement can be expected from these sources. However, the middle class of manufacturers are always alive to any good thing brought to their attention, and will give their opinion, whether a patent be basic or combination, if the matter is put to them as a business proposition. There are others again who will frankly state that the invention appears to contain some merit, but they personally are not in a position to take it up. It must not be thought that all those who believe they can see a dollar in an invention are ever ready to jump right in and squeeze it out. There is a market for all good inventions. Find out first if it is good, then patent it and push it for all it is worth.

Electrically-Driven Centrifugal Pumps at La Grange, Ill.

The North Shore Electric Company which supplies central station service in the majority of suburban towns around Chicago has recently placed centrifugal pumps in its combined water and electric light plant at La Grange. This installation is one of considerable interest, both to central station companies that contemplate doing waterworks pumping and to those doing it already, but contemplate changes or additions in the present pumping plants. The centrifugal pump has for some time been recognized as a very simple piece of apparatus for use when connected direct to electric motors. Nevertheless, it has not yet been used much for waterworks pumping.

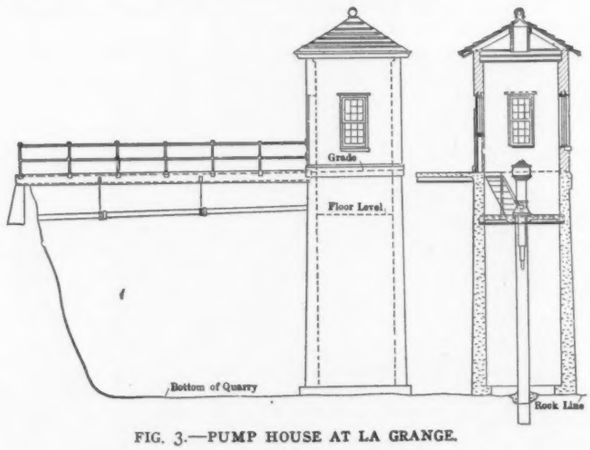


FIG. 3.—PUMP HOUSE AT LA GRANGE.

The La Grange plant comprises both deep well pumps for raising the water from the well to a surface reservoir, and also pumps for raising from the surface reservoir to a standpipe. One of the deep well pumps has been in operation in regular service for several months. Another one is to be installed in an adjoining well.

Fig. 1 shows the general plan of the deep well pump, while Fig. 2 is a drawing giving more of the details. From Figs. 1 and 2 it will be seen that the pump is of the three-stage type and is located 80 ft. below the surface in the well. The suction pipe of the pump extends 30 ft. more, making a total depth of 110 ft. from which water can be drawn. The motor which is at the surface drives the pumps through a long ver-

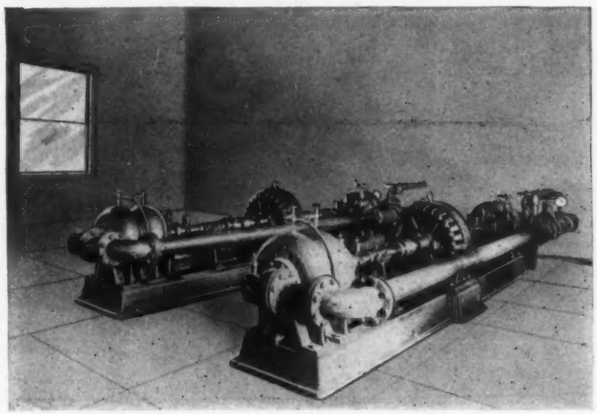


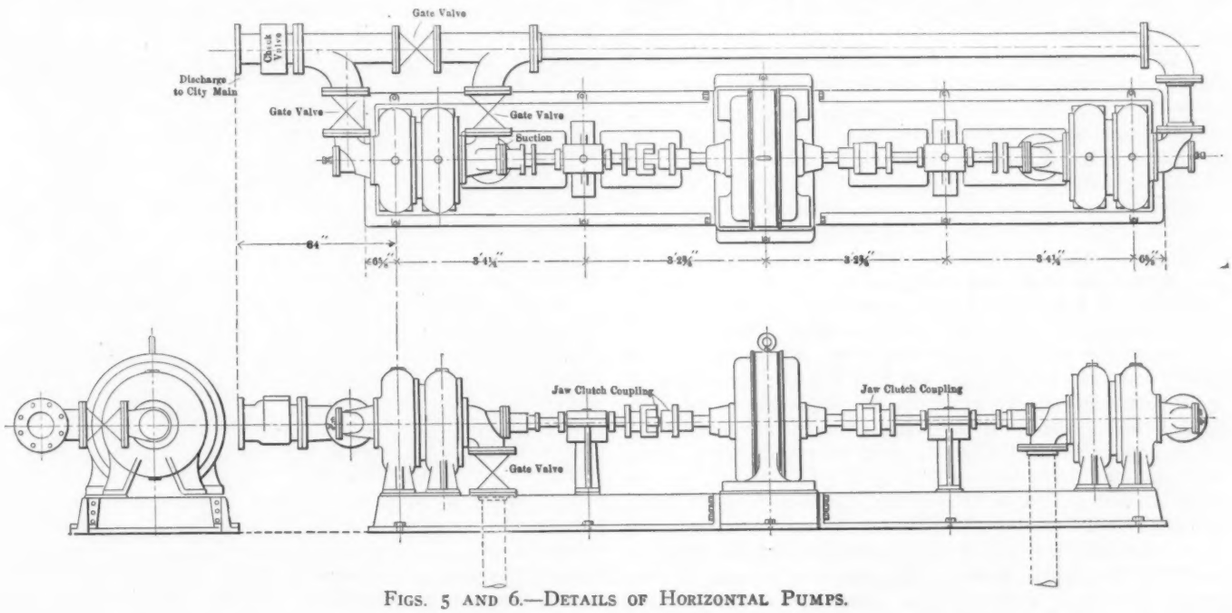
FIG. 4.—HORIZONTAL PUMPS AT LA GRANGE, ILL.

tical shaft. The pump is only 13 in. in diameter over all. The water was formerly pumped from this well by a compressed air outfit. In order to accommodate the centrifugal pump it was necessary to ream out the top of the well to a depth of 120 ft. The cost of this reaming on one well was about $1,500. As the upper part of the well was drilled through solid rock, it was not provided with a casing; consequently there was no expense for removing a casing when the reaming was done. The total depth of the well is 2,014 ft. The ordinary depth of water when pumping is about 63 ft.

The centrifugal pump was made by the Byron Jackson Machine Works, of San Francisco. It is driven by a Westinghouse three-phase, 440-volt induction motor running at 1,120 r.p.m. The pump discharges into an 8-in. pipe which takes the water to the surface. In the middle of this 8-in. pipe is a 4-in. pipe, and inside of the 4-in. pipe is the driving shaft. Every 8 ft. in the 4-in. pipe is a babbitted bearing to keep the vertical shaft in line, as indicated in Figs. 1 and 2. The shell of this babbitted bearing served also as a coupling for the 4-in. pipe. Each alternate bearing is steadied or held firm within the 8-in. pipe by means of cap screws with jam-nuts placed 120 deg apart around the bearing. These cap screws are adjusted to hold the bearing in center with their leads against the inside of the 8-in. pipe, and the jam-nuts are then tightened.

The motor is connected with the shaft by a leather link flexible coupling. The weight of the armature is taken by the shaft thrust bearings. At the top of the well two kinds of thrust bearings are provided. One of these is a ball bearing which takes the weight of the armature shaft and pump runners while the pump is starting up. After it is started the weight is taken by a hydraulic bearing supplied with water under pressure from the water works mains. The hydraulic bearing, which is similar in principle to the step bearings used under steam turbines, consists simply of a disk upon which the weight is placed and under which a film of water is forced so that the weight is carried by this film of water. The shaft cannot be raised by the water pressure very far because the increased opening caused by the raising of the shaft would immediately cause a drop in the water supply pressure because of the restricted inlet for the water. This deep well pump discharges into a reservoir at the surface. Pumping from the reservoir to the standpipe is done by a set of horizontal shaft centrifugal pumps which will be described later.

It is notable that considerably greater output has been obtained from this well with the centrifugal pump than could be obtained from it with the compressed air outfit formerly employed. Although the results were doubtless partly due to some leaks since there was no casing in the upper part of the well, which was in solid rock, there are nevertheless probably many compressed air outfits in operation to-day which are in no better condition. The pump now in operation is delivering from 400,000 to 450,000 gal. of water from one well per day. By weir measurement it pumps at the rate of 428 gal. per minute. The rated capacity of these pumps working against 100-ft. head is 350 gal. per minute. The two wells at this plant are located in a pit because when the water works were first built at La Grange an abandoned stone quarry was selected as the site so that the quarry excavation could be used as a fire reserve reservoir. It is no longer so used, but it is nevertheless necessary to provide a pump housing somewhat different from that which would be necessary if the wells were not in this pit. Fig. 3 shows an elevation of the pump house, which will stand on the rock bottom of the old quarry about 25 ft. below grade. The plan is to fill up the quarry to grade, as indicated on the drawings.



FIGS. 5 AND 6.—DETAILS OF HORIZONTAL PUMPS.

For raising water from the surface reservoirs to the standpipe two pumping sets are provided of the kind shown in Figs. 4, 5 and 6. Each set is driven by a 50-hp Westinghouse, three-phase, 440-volt induction motor running at 1,120 r.p.m. On each end of the motor shaft is a jaw clutch coupling by which it can be connected to a two-stage, horizontal shaft Byron-Jackson centrifugal pump. The arrangement of piping and valves is such that either pump can be operated alone or the two pumps can be operated in multiple for ordinary pumping into the stand pipe. The maximum pressure against which they must pump when the standpipe is full is 54 lbs. per square inch; it averages about 50 lbs. In order to put a fire pressure of 90 lbs. on the mains it is necessary merely to connect these two pumps in series and close the valve between the mains and the standpipe. The rated capacity of each set of two pumps is 700 gal. per minute pumping in parallel against 138-ft. head and 350 gal. per minute pumping in series against 221-ft. head. This arrangement is extremely flexible.

For the ordinary pumping at the present time, it is customary to run one motor connected to one pump during the entire 24 hours, except during the peak load in the evening and for about an hour every forenoon. Of course the motors operate somewhat underloaded, but since the point of maximum efficiency on an induction motor occurs at a load considerably less than the maximum it can carry without overheating, the motor is not running at an inefficient point. The practice in case of an alarm of fire is to connect the two pumps of one set at once in series and let them discharge into the standpipe. As long as they are discharging into the standpipe the pressure, of course, does not rise above normal. When the pumping station is notified by the chief of the fire department to put on fire pressure, it is necessary merely to put the remaining set in series and close the valve between the water mains and the standpipe and the pressure will at once rise to 90 lbs. As a matter of fact the pumps connected in series when not delivering much water will increase the pressure to 110 lbs. In order to prevent the pressure from ever getting as high as 110 lbs. a safety valve bypass has been provided by which a certain amount of water is allowed to bypass into the reservoir whenever the pumps raise the pressure above 90 lbs. Centrifugal pumps when run at constant speed will maintain a fairly constant pressure pumping direct into the mains as is done in the present instance.

The current supply for this La Grange plant comes from a large power station of the North Shore Electric Company at Maywood, a suburb several miles north of La Grange. The transmission system of the North Shore Electric Company was described in the Electrical World of February 24, 1906. The La Grange electric light and water works service was formerly obtained from a steam plant. The water works pumping was done by steam. When the present changes are completed the load will be carried regularly from the power house at Maywood over the 10,000-volt transmission line. A very substantial fireproof sub-station is being completed and the horizontal shaft pumps are located in this sub-station. The deep well pumps are in the small pump houses near the sub-station. A part of the old steam plant will be retained as a reserve to give water pumping service in case of any long continued storm which might cause interruption of the transmission line. None of the steam pumps will be retained, however. The centrifugal pumps will be relied on entirely for the pumping, as both the deep well pumps and the standpipe pumps are in duplicate. A high-speed steam engine driving a 100-kw, three-phase, four-wire generator will form the steam reserve at this substation. The steam reserve will, therefore, be available for either lighting or water pumping purposes.

The entire installation was designed for the North Shore Electric Company, of which Mr. Frank J. Baker is vice-president and general manager, by Sargent & Lundy, consulting engineers, and installed under the immediate supervision of Mr. J. M. Strasser, superintendent of District "G" of the North Shore Electric Company.

Equipment of the Public Service Company of Mooresville, Ind.

At Mooresville, Ind., a rapidly growing town of about 2,000 population, near Indianapolis, is found an example of a combined electric light, steam heating and water works plant operated by one company, in a town where it would be difficult to make a waterworks pay alone. The Public Service Company of Mooresville was granted a franchise by the board of trustees on February 4, 1904. The franchise, in addition to

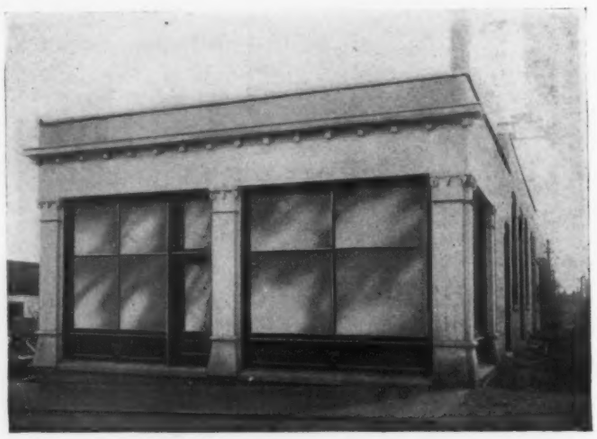


FIG. I.—MOORESVILLE PUBLIC SERVICE COMPANY'S BUILDING.

giving the company the right to use the streets for water works, electric light, gas and heating plants for 50 years, further specifies that the company shall furnish the town 15 public lamps "known as 1,500 candle-power," and shall maintain these lamps according to the Philadelphia Moonlight Schedule up to 1 o'clock each night at a monthly rate of $6.50 per lamp. In case any of the lamps are not lighted, a deduction of one-fifteenth of $6.50 shall be made for each night each lamp is out, unless such failure is occasioned by causes beyond the control of the company. The company is required to furnish additional public lamps as before defined over and above 15 in number for a rental of $5.75 per lamp per month if required by the board of trustees. The company also agrees to furnish the town of Mooresville with at least 25 fire hydrants each supplied with places for attaching two nozzles, for a rental of $40 per hydrant per annum, payable in 12 monthly installments during each year. Additional fire hydrants must be furnished at $35 each. As to the rates to be charged to private customers, the ordinance says that the Public Service Company shall be allowed the right of free contract with the citizens of the town of Mooresville for heat, light, power and water, but all contracts made by the Public Service Company for like service, amounts or quantities under like terms of measurements, or payments as to time, etc., shall be equal and no discrimination or favor shall be shown to one person over another. At the expiration of 20 years, if the voters of the town of Mooresville express a desire by a majority vote on popular ballot to take over and operate the works and plant of the Public Service Company, the town authorities may so acquire the same when legally so empowered to do, by paying an agreed purchase price which shall not exceed 115 per cent of the cost of the plant, and the town may have access to the books and papers of the company with a view to ascertaining the cost. If a valuation cannot be agreed upon, it shall be submitted to arbitration, each party choosing one arbitrator. If these two arbitrators fail to agree, the judge of the circuit court of Morgan County shall have power to choose a third arbitrator, any two of whom may fix the price.

DESCRIPTION OF PROPERTY.

The power plant, offices and storeroom are housed in a building 36 ft. by 99 ft., located a block from the principal

business corner. This building, illustrated in Fig. 1, is of thoroughly substantial construction, being of brick with concrete foundations and floors, and Bedford stone front. It is a one-story building 22 ft. high with a tar and gravel roof. It is about as near fireproof as it can be made. The lot upon which it is located is considerably lower than the business part of the town which is supplied with steam heat. This location is desirable because of the easy return of the condensed steam from the heating system. The building is not near any steam railroad, but a spur may be run in the future from the Indianapolis & Martinsville electric road, which is only a block distant. The boiler room contains two 100-hp Chandler and Taylor horizontal return-flue boilers and two Fairbanks-Morse feed water pumps. The generating equipment, shown in Fig. 2, consists of a Chandler and Taylor 50-hp engine belted to a 30-kw Commercial 230-volt, direct-current generator and a Westinghouse 75-hp high-speed engine direct-connected to a 45-kw Westinghouse generator of similar voltage. Water pressure on the mains is kept up by a Holyoke-Dean service pump having a daily capacity of 1,116,000 gal. The company's principal well, which is located back of the power house, is 14 in in diameter and 47 ft. deep. The water from this well is elevated by a steam deep well pump. About a block distant is another well 8 in. in diameter by 311 ft. deep. Water is raised from this well by a bulldozer deep well pump belted to a 1½-hp motor. The water supplied is pumped from the wells into a concrete cistern under the office and storeroom part of the company's building. This cistern holds 43,800 gal.

The town is surrounded on two sides by creeks which tend to prevent it spreading and so keep down the investment in distributing systems both for electric light and water. Because of the compactness of the town, the 220-volt, direct-current, two-wire system of distribution was selected. The street arc lamps are 220-volt, 2¼-amp., supplied from a pair of mains separate from the private lighting. There are 23 of these arc lamps in service. The line drop between the station and lamps on peak load averages 5 volts. Free lamp renewals are given. The peak load in December, 1906, was about 250 amperes at 225 volts. There are about 160 electric light customers and 9 steam heat customers.

The steam heating is done by exhaust steam from the pumps

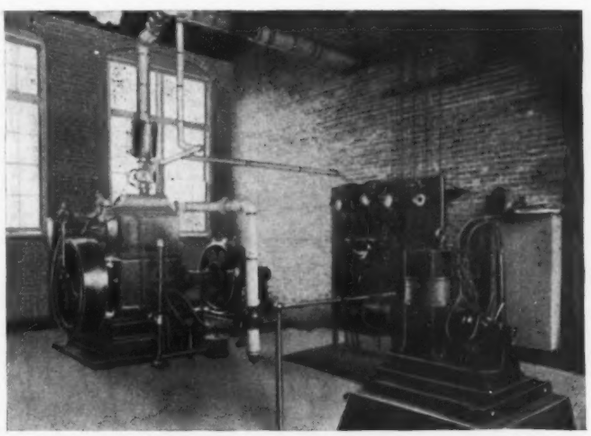


FIG. 2.—VIEW OF INTERIOR OF MOORESVILLE PUBLIC SERVICE PLANT.

and electric light engines, although some live steam is necessary during the day. The American District Steam Heating Company's system is used. Condensation from the radiators is piped back to the plant. A number of customers have installed economy coils through which the hot water from the condensed steam circulates after it leaves the radiators and before it passes to the meters, thus obtaining the benefit of some of the heat stored in the water.

The plant is operated by two engineers, each on duty 10 hours, and one engineer on duty 4 hours per day. The latter man spends the balance of his day on repair and trouble work. The company also employs one outside man.

RATES.

The company has a system of meter rates and a system of flat rates, but the flat rates are purposely made high in order to induce customers to use meters. Lighting rates are 13½ cents per kw-hour with a discount of 10 per cent for payment within 10 days. The minimum bill is $1. The water rate is 50 cents per thousand gallons, with a minimum bill of 40 cents. The ordinance specifies nothing in regard to rates, except that there shall be no discrimination between customers of the same class, as before noted. Steam heat is all sold by a meter which measures the amount of condensed water. The rate on this is 50 cents per thousand pounds of condensation, less 10 per cent for payment within 10 days.

FINANCES.

The plant is valued at $44,000 in a report made by the American Engineering Company, September 5, 1905, the original cost being given as $45,403. Owing to the advanced prices of iron and copper, it would cost considerably more than this to duplicate the plant to-day. The company's gross income and operating expenses for the months of October, November and December, 1904 and 1905, were as follows:

Gross Income, October, November and December, 1904.	
Light	$894.74
Water	325.93
Construction profit	258.10
Heat	145.93
Total	$1,624.70
Operating Expenses.	
Wages	$690.00
Coal	467.00
Sundries	321.66
Total	$1,478.66
Gross Income, October, November and December, 1905.	
Light	$1,216.01
Water	422.38
Construction profit	256.76
Heat	100.92
Total	$1,996.07

Sundry expense contains general expenses, interest and discounts, insurance, taxes, repairs, renewals, postage, printing, advertising, and legal expenses. For the year 1905 income and expenses were as follows:

Gross Income, 1905.	
Light	$4,098.33
Water	1,611.48
Construction profit	905.63
Heat	441.99
Total	$7,057.43
Operating Expenses.	
Wages	$2,760.00
Coal	1,231.58
Sundries	682.70
Total	$4,674.28
Net income	$2,383.67

The company issued in 1904, $24,000 in 20-year, 5 per cent gold bonds. The bond interest and sinking fund is, at the company's request, paid directly by the city treasurer to the trustees for the bonds and sinking fund; the payments by the city for the first 15 arc lamps and the first 25 fire hydrants being just about sufficient to pay the bond interest and retire the bonds within the time specified. As supplementary to the foregoing statements of income and expenses, the following statement showing the income for the month of October, 1904, 1905 and 1906 is of interest:

Gross Income October.	1904.	1905.	1906.
Light	$262.43	$377.20	$406.21
Heat		9.50	13.50
Water	136.41	185.28	259.03
Construction profits	75.94	72.96	9.78
Total	$474.78	$644.94	$688.52

From these statements it is evident that the growth of the electric lighting business at the start in a plant of this kind is much more rapid than that of a water plant. The percentage

or earnings on investment in the electric light department although not shown by these statements, must be considerably higher than in the water plant, because the water plant costs more and earns less. It is slower work building up the water business than the electric light business. The town is not yet provided with sewers, although it probably will be shortly. This improvement will give a great impetus to the water end of the business. It is probable that the water business will show henceforth a better rate of increase than in the past and will appear better in comparison with the electric end.

The property is under the management of Mr. B. V. Hubbard, secretary, who is also organizing the Arctic Ice Company, which is to obtain its power by rental from the Public Service Company. The ice plant will be located on the same property as the Public Service Company's equipment, the ice machine being located in the present engine room, and the balance of the plant in a building back of the present building on the same lot. When the ice plant is started, the electric plant will probably be operated 24 hours a day. It is now operated during only the first part of the night and early in the morning.

The Construction of Induction Coils.

By Wm. O. Eddy.

THE present article, which is supplementary to preceding papers on this subject, treating some of the theoretical considerations and the technical designs of induction coils, deals with the methods of practical construction and the more important manufacturing details.

The principal elements of a good 6-in. coil are as follows: The secondary coil wound with No. 34 single silk-covered wire in "pies" ⅛ in. thick and the following sizes: 14 3½ in. inside diameter by 4⅞ in. outside; 20 3¾ in. inside diameter by 4⅞ in. outside diameter. The insulating tube is made of hard rubber 14½ in. long by 2¼ in. inside by 2¾ in. outside diameter. Two layers of primary wound with No. 12 double cotton-covered wire on a core 12½ in. long.

A method of construction frequently employed is here described; advantageous variations may suggest themselves to those who bear in mind the principles involved.

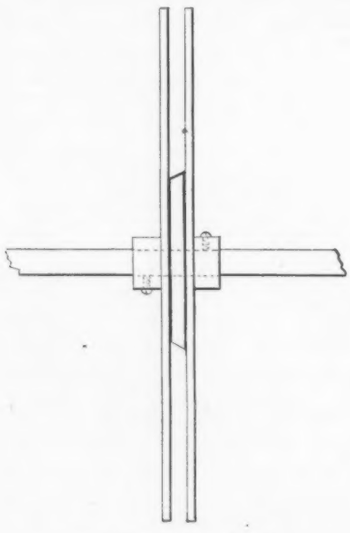


FIG. 1.—WINDING FORM.

The separate coils of the secondary are wound all in the same direction by a lathe on a form made of brass discs such as is shown in Fig. 1. There are several of the small central discs made with different diameters and thicknesses. Since one man can watch two forms at the same time, there are, where many coils are to be wound, two of these on the same spindle.

As the wire is being wound it goes through a bath of hot paraffin wax, the wire passing under a rod beneath the surface. The number of turns that can be wound in a given space will depend on the temperature of the bath, the amount of insulation used and the tension with which the section is wound. The superfluous wax is taken off by passing the wire through slits in one or more pieces of paper as it leaves the bath, the number

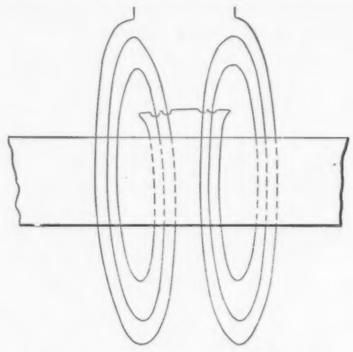


FIG. 2.—INTERCONNECTED SPIRALS.

depending on the amount of wax desired. The bath should be near the revolving form so that the wax may not get cold before the wire is wound in place, since it is the paraffin that holds the wires together. In the above design No. 34 single silk-covered wire is so wound that 900 or more turns are contained in a cross-section ⅛ in. by 1 in., which gives approximately 38,000 turns for the entire secondary. The sides of the form are easily separated from the winding by applying a little heat if they stick; the bevel on the central piece rendering this separation easier.

A further advantage of this bevel is found in the assembling of the coils. By referring to the diagram of the two single spirals (Fig. 2) it is seen that the method of connecting the inside to inside and outside to outside of alternate coils requires that every other coil should be wound in the opposite direction so that the two may not oppose each other in magnetomotive force. This effect may be obtained by reversing one of the two coils. These coils may, therefore, be assembled in pairs with the required number of discs of insulating paper between them, the inside ends of the wires being connected and soldered together. A slit is made in the paper for the wire to pass through, there being no difference of potential at this point. With the coils thus beveled it is possible to tell at a glance how they should go without having to trace out the winding in each case, thus minimizing the danger that a careless workman may get two of them in opposition.

Having connected the coils in pairs these pairs should be assembled, a pair at a time being laid on those beneath with sheets of insulating paper placed between them, and the outside connections made, tearing another slit in the outside of the paper sheets. There is no danger of getting any pair in opposition to the rest if adjacent coils are always connected together; but the several pairs and also the assembled sections should be tested to discover any faulty coil or connection. A slight twist about the axis will take up the slack of the connection and care should be taken to keep all the coils and paper discs true about the same axis.

It is best to have the entire secondary built in several sections or parts, each of these being treated in a vacuum impregnating apparatus. In case the vacuum system cannot be employed it is best to drive out all the moisture by heating the sections in an oven at about 120° C. and then to transfer immediately and boil out in the insulating compound. The wire itself before winding the pies should of course have been heated to drive out all moisture. For the insulating compound a mixture of three parts of rosin to one of beeswax should be used; the larger the proportion of rosin the more brittle this insulation will be, while too much wax makes it too plastic. This com-

pound should not be allowed to get too hot or its insulating qualities will be impaired.

After boiling the winding until the bubbles cease to rise, the sections are cast in the same compound, the outside of the casting being the same diameter as the paper discs. There should be cast in the center a brass tube which is afterwards drawn out, the outside diameter of this being that of the insulating tube. The end sections should have considerable insulation beyond the winding, and in this are cast the hard rubber terminal posts containing the ends of the secondary winding

The several sections are now assembled on the brass tube and more insulation cast on the outside diameter to such a depth that the spark will not jump through and into the winding. This

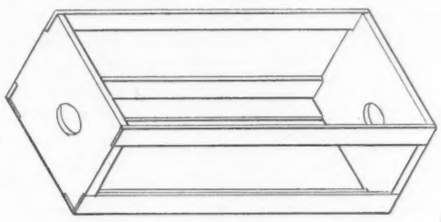


FIG. 3.—FRAMEWORK FOR COIL.

may conveniently be done by supporting the secondary in a horizontal position and using a sheet of tin rolled into a hollow cylinder for a form and two discs of wood for the ends. The same piece of tin will serve for several sizes of coils since it is very flexible. The two edges of the tin are made to lap at the top of the coil and here the hot insulating compound is poured in and allowed to cool before the tin and end pieces are taken off, the ridge at the top being then smoothed off with a hot iron.

The secondary is supported by the insulating tube which is held by the framework shown in Fig. 3. This has one open side to receive the secondary, and after the winding has been slipped in place the insulating tube is pushed from one end through the center of the secondary and into the hole in the opposite end of the framework. The whole secondary and supporting framework are now ready to be placed in the cabinet or box used for mounting the coil. The cover with holes cut for the secondary terminal posts to project through is now screwed in place, and hard rubber collars are arranged to cover the edges of the holes around the posts.

If the coil is not to be enclosed in a cabinet the secondary is covered with a thin sheet of hard rubber which is heated and bent into a cylinder to conform to the outside of the coil; the edges of this cylinder are laced together and the line of joining turned out of sight on the under side of the coil. In this method no framework is used and two uprights take the place of the ends of the cabinet and support the insulating tube, which in turn supports the primary and core by means of the cap, which fits into it (instead of into the cabinet, as shown in the cut).

It is difficult to bind and wrap the bundle of iron wire composing the core tightly in a true cylinder on which to wind the primary. Another course is therefore adopted as follows: A cylinder of wood the exact size of the core is sawed diagonally into two equal wedge-shaped parts. Over this cylinder is wound with shellac a number of layers of paper, which will serve between the core and the primary. At each of the two ends there is slipped on a tightly fitting ring or washer made of wood or hard rubber. These collars are to secure the primary winding, and they are held in place by shellac and each has a hole drilled through it for the purpose of providing an exit for the ends of the wire.

Now in a lathe wind the primary over the paper and between the collars; soak the winding with shellac and bring out the ends of the wires through the holes in the collars. These details are shown in the cut, which gives a cross-section of the mounting of one end of the coil and illustrates better than words the construction.

When the primary winding is dry the two halves of the wooden cylinder are easily drawn out, leaving a substantial tube which will retain its form while it is being filled with the iron wires, which compose the core. These can be packed in remarkably tight by pushing in a few more single wires after the space is apparently full. It is unnecessary to add that all the wires should be of equal length if good appearance is desired.

In the method of mounting shown the primary and the core are supported by a ¼-in. soft steel rod which must be put in with the wires. This runs through the center of the core and projects at each end where it is threaded. The details of one end of the coil are clearly shown in Fig. 4. A wooden or hard rubber disc—wood is less expensive—is now threaded on each end of the projecting rod and held firmly against the ends of the core wires by a nut as indicated in the engraving.

The primary and core are now ready to be slipped into place inside of the insulating tube through the hole in the end of the cabinet. A hard rubber cap covers this hole and on it are mounted the binding posts for the primary connections, while a polished brass nut secures the cap and the end of the steel rod. At the other end of the cabinet (in the absence of primary connections) there is only a hole for the ¼-in. rod, which passes through to the outside where provision is made for holding the end by a brass nut.

The primary and core are thus made a unit, but independent of the secondary, and they must be removed before the secondary can be taken out. Coils are sometimes provided with two primaries with cores which can be interchanged for different conditions of working.

The condenser is built up of alternate sheets of tin-foil and impregnated paper. The paper sheets are cut larger than the foil to prevent sparking around the edges while the sheets of foil are made to extend beyond the paper alternately at opposite ends so that they may be clamped together in electrical contact. The whole bunch is bound together at one end, but at the other it is divided into a number of sections by slipping in a sheet of paper for insulation at intervals. These separate sections are afterwards connected to a series of buttons or

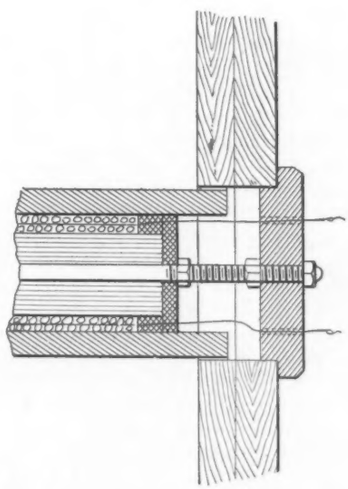


FIG. 4.—ARRANGEMENT OF END OF COIL.

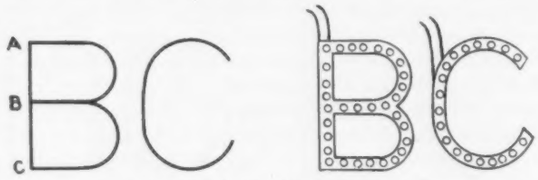
switches so that any number may be joined in circuit, thus giving the adjustability feature to the capacity. The condenser is usually placed in a shallow compartment under the base of the coil, and the outside of this compartment is often used for the location of the various switches and regulating devices.

When so desired an elaborately finished cabinet and mounting may be had, and adjustments, meters and accessories added as dictated by the fancy of the individual.

Practical Hints on Electrical Decorations.

By Wm. Kavanagh.

Engineers and electricians are often required to decorate electrically a hall or ballroom such decoration being generally temporary. If letters are required in the plan of such decorations they can be either hired or purchased from any electrical supply house. Letters procured in this way, however, are often too mechanical and inartistic, and, if time will permit letters of artistic design and attractiveness may be constructed in a surprisingly short space of time. The letters are first drawn on



FIGS. 1 AND 2.—ELECTRICALLY LIGHTED LETTERS.

some level surface (such as a drawing board, partition or floor) to suit the design and size required; then by forming a stout wire to the design thus made we can wire the lamp sockets and attach the whole to our wire letter.

Take the letters B, C, Fig. 1, which letters we will say stand for "bachelors' circle." The letter C can be formed from a single piece of wire, while the letter B can be made out of two or three pieces and soldered at *A, B* and *C*. The wires to carry the current are placed around the wire frame or shape, when the sockets can be attached as shown in Fig. 2. After the sockets are in position the frame and wire are covered with any

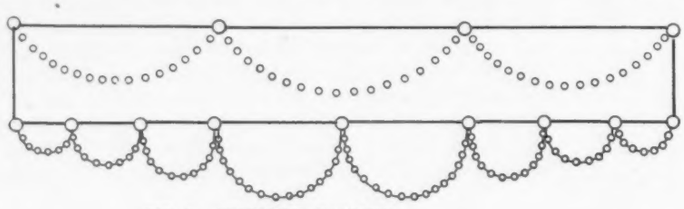


FIG. 3.—FESTOONED BALCONY.

fancy-colored cloth, and of course the sockets can be covered with the same material. The cloth can be cut in narrow strips and by winding it around the various parts the letter can be made to present a very neat appearance. It will be seen that letters constructed in this way are partly flexible and can be bent to suit any defect in their original formation.

Festooning is an important branch in the art of decoration, and Fig. 3 illustrates a balcony festooned. In decorating after this manner the most difficult thing is to locate the length of the mains and number of lamps and their distance apart. A very handy way to determine the length of the mains or circuit is to string a cord or rope to represent the festoons required, from which measurements can be taken and transferred to a wall or ceiling. After the measurements are located, wall hooks or other similar contrivance can be driven at various points of the curve, the hooks serving to hold the mains while they are being bent to suit the required festoons. After the mains or leads are in shape, the number of lamps and their distance apart can be readily fixed, the distance between lamps being generally decided by the taste of the decorator.

Incandescent lamps of various colors and shades enter largely into decoration work, and in most cases the electrician does his own coloring or shading; few, however, *engineers or electricians*, are capable of producing colors or shades to compete with those sold by supply houses, and the dipped or colored lamps bought from the same source will usually surpass the lamps colored by the electrician, the reason for this being that the latter, after dipping the lamps, is apt to allow them to lie horizontally instead of vertically, thus preventing the coloring fluid from evenly distributing itself over the surface of the glass, and also through handling of the lamps before they are thoroughly dry. A very good plan to follow in dipping lamps is represented in Fig. 4, showing a board fitted with a series of holes into which are forced pieces of spring steel wire to hold the lamps. After the lamps are dipped they are placed between the wires where they can remain until dry. The end view shows the board standing on its edge and hence the lamps when drying will be in a vertical position, thus enabling the coloring fluid to distribute evenly itself all over the globe surface. Fig. 5 illustrates another method of holding the lamps in position for dipping and drying. A wire or string, A B, is stretched taut between two supports on which are tied a number of short strings from which the lamps are suspended. A vessel containing the coloring liquid is now passed under the lamps and by holding the base of the

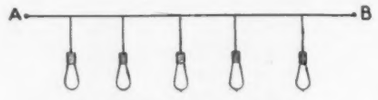


FIG. 5.—COLORING LAMPS.

lamp with one hand, the vessel containing the liquid can be lifted up sufficiently high to immerse and color all of the globe; then by lowering the liquid any surplus coloring will drop back into the vessel. In this way each lamp is colored, and, of course, they remain hanging until dry. The wire method of holding the lamp is the quickest, as using the strings involves a loss of time, since each lamp must be tied and untied. With the wire method it is only necessary to dip the lamp and then push the socket between the wires; if a small trough is placed beneath the lamps it will serve to keep the coloring liquid from staining the bench or floor.

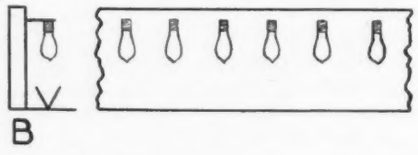


FIG. 4.—COLORING LAMPS.

Properly constructed arches play an important part in electric decoration. Suppose some arches are to be erected in a hallway or entrance, the width of the arch to be 16 ft., and the rise or spring of the arch to be 4 ft. Referring to Fig. 6, draw A B equal to 16 ft. and locate its center at O; from the point, O, erect O N perpendicular to A B and make O N equal to 4 ft.; now extend O N indefinitely in the direction of P and draw N

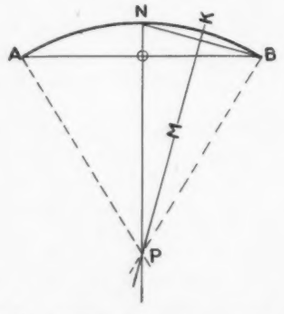


FIG. 6.—CONSTRUCTING AN ARCH.

FIG. 7.—ILLUMINATED ARCH.

B, locate the center of N B and from this point as K erect the perpendicular K M and extend it to cut the line, O N. The point where O N and K M cut each other will be the point from which we draw the required arch; we find K M cuts O N at the point, P, and from that point with a radius equal to A P or B P draw the arc, A N B, which will be the curve to guide in

bending or forming the arches. In making such curves a chalked string and long straight edge will be needed, and also some chalk pencils. The perpendiculars can be erected by means of a string or carpenter's square, and the arches can be constructed from ¼ in. or ⅜-in. steam pipe or from heavy wire. If there is no simple way of supporting those arches, they can be made with pipe legs, as shown in Fig. 7. After the arches are up, the circuits with sockets attached can be run around each arch and securely fastened ready to receive smilax or other decoration.

Sometimes a flash light effect is required, and a very simple way to produce such an effect is as follows: Make a trough out of sheet iron, and of any desired length, into which pour some photographer's flash light powder, the powder extending nearly the length of the trough in rope form. At one end of the trough and lying in the powder is placed a small fuse which will form a short-circuit when the line to which it is attached is closed, a switch being provided for this purpose. At the moment the flash is required, the switch is closed, when the fuse will instantly ignite the powder, producing a flash light the luminosity of which will depend on the amount of powder and the length of the trough. It will be understood that if the trough is long, considerable time will be required to burn the powder strewn along its surface; should the powder be placed in the trough or vessel in bulk, the duration of the flash will be much less. Powders producing various colors can be burned.

Wiring a Frame Dwelling with Flexible Metallic Conduit.

By Thomas W. Poppe.

Great care should be taken to have all outlet boxes set flush with the wood or plaster as the case may be. In woodwork a special box termed a wall case is used. This fits snugly in the wood and does not require the removal of woodwork to set the box in the plaster or brick behind the woodwork. This will be thoroughly explained later on.

After the locations of the panels have been determined the number of circuits running from a panel are counted and ⅞-in. holes are drilled for the requisite number of tubes in a wooden box in which the slate panelboard is fastened, after the wires are drawn into the conduit.

The wall is then cut away so the box can be set flush with the plaster, which is done in all cases whether the finish is plaster or wood. Where the room or hall is finished in wood the door of the panel box will be formed by the finished woodwork and if the box was set flush with the woodwork the door of the panel would necessarily project outward, giving a bad appearance.

After sufficient wall has been removed the box can be set as shown in Fig. 1. In one case, illustrated, on each side of the box bricks are removed from the wall and white pine plugs driven in the cavities thus formed. The box is then fastened

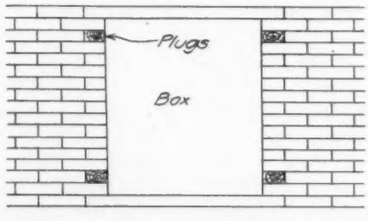


FIG. 1.—INSTALLING PANEL BOX.

to the plugs with screws. Cement is then forced into all cavities surrounding the box. Where the partition or wall is constructed of framing the uprights of the framework are built out to meet the sides of the panel box. The boxes are not as a rule narrower than eighteen inches and as the uprights of the framework are generally only fourteen inches apart, sixteen inches between centers, it is often necessary to remove as much of the obstructing upright as needed. As it will be necessary to saw or cut the upright in position, it should be braced above the cutting point by nailing pieces of two-by-four joist between the obstructing upright and the ones on either side. The box is then set and the tubes entered as shown in Fig. 2. Nippies

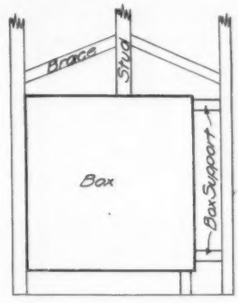


FIG. 2.—INSTALLING PANEL BOX.

1½ in. long should be made of ½-in. rigid conduit and screwed into combination couplings. The couplings are then fastened to the conduits. The nipples are then inserted into the ⅞-in. holes in the panel box and securely fastened by means of lock nuts screwed on that part of the nipple projecting into the box and firmly fastened against the wood. The combination couplings will prevent the nipples from entering the box and the locknut will prevent it being pulled out. Fig. 3 shows the panel as described set ready to draw the conductors into the tubes.

At the panel box the flooring is removed to a point about eighteen inches from the wall and about twenty-four inches wide. At the first outlet on the circuits the flooring is also removed, making what is known as a pocket. Judgment should be exercised in taking up flooring. If the flooring is expensive it might be cheaper to cut a hole in the ceiling below.

When these preparations have been completed a wireman lies upon the floor at the box and pushes a snake (a steel spring tape about 1/16 in. thick and ⅛ in. wide and as long as desired) between the beams to the pocket at the first outlet. It may happen that the beams may cross his path instead of running

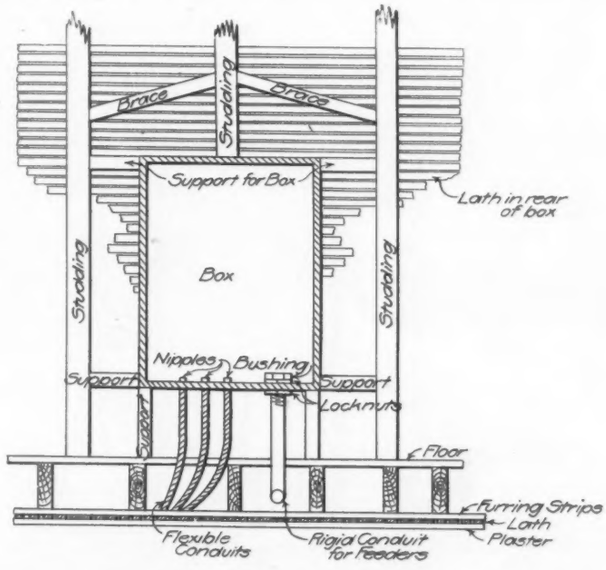


FIG. 3.—PANEL BOX IN POSITION.

parallel to it. In this case he must push his snake under the beams between the beams and the lath. This can be done only where furring strips have been nailed to the beams and the lath nailed to the furring strips. The furring strips are about ⅞ of an inch thick and permits a flexible tube for No. 14 B. & S. duplex wire to be drawn beside it under the beams.

Should there be no furring strips and the lath be nailed direct to the beams, as much flooring as necessary should be taken up and a notch about one inch deep and one inch wide should be cut across every beam necessary. This admits the tube and allows the flooring to be replaced. When cutting the beams for the tube one should, if possible, cut above or near a supporting partition, as the depression made tends to weaken the beam if made towards the middle.

After the snake has been pushed from one pocket to the other

FIG. 4.—DRAG FOR CONDUIT.

a strong sash cord is attached to the snake and it is drawn out, drawing with it the sash cord. At one end of the sash cord a "drag" (Fig. 4) should be securely fastened, which can be screwed into the conduit. The sash cord is then drawn out, thereby drawing in the conduit. Should the conduit refuse to enter the space between the beams and the lath a piece of steel-armored cable of a smaller diameter than the conduit should be drawn into the space and pulled back and forth several times. This can be done by a man holding each end of the cable and pulling it back and forth in a manner similar to men using a whip-saw. This breaks and removes the plaster where it has been pushed between the lath when the ceiling below was plastered. The tubing should then be attached and drawn into the raceway thus made. The tubing in place is shown in Fig. 5.

The outlet box is then set. If the box sets in brick and is intended for a bracket the box must be set with plaster of paris and a chase cut into the wall down to a point below the floor to admit the concealment of the tube. If the partition or wall is of framework the box is set as shown in Fig. 6. A piece of board is fastened from upright to upright and the box fastened with screws to the board. A piece of twine with a piece of plumber's chain or a small leaden ball attached is lowered into the space under the outlet box to the space between the beams. It may be necessary to cut a way through the flooring directly under the outlet and behind the baseboard to allow the "mouse" (the chain or leaden ball) to pass. The sash cord is then attached to the twine and pulled upward with it. The tubing is then attached to the sash cord and drawn upwards and fastened permanently in the box by means of a combination coupling and a chase nipple. From outlet to outlet the same proceeding is followed.

The switch boxes are set in the same manner as the outlet boxes mentioned above, except where woodwork is encountered, when a box 2¼ by 3 in. by 4 in. deep and made of sheet metal 1/16 in. thick is used. This is known as a wall case. The woodwork is so cut as to allow the wall case to fit in the opening made very snugly. The wall case is fitted with screw holes in a projection on each end. The box is firmly fastened to the wood with screws. The wall case is also fitted or contains holes filled with round discs which can be knocked out with a

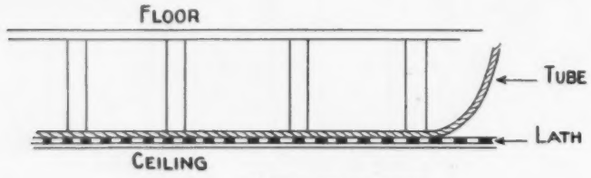


FIG. 5.—CONDUIT IN POSITION.

hammer. In the opening then made the conduit is fastened by means of a combination coupling and a chase nipple. The same style box is also used for base plugs, which as a rule set in the wooden base.

In bathrooms where tile is used it is well to run the conduit in the adjoining rooms and enter the outlet boxes through the rear. Where switches or base plugs are set in the tile it is well to allow the box to project out beyond the tile about half an inch. A wooden frame, termed a "mat," is placed surrounding the outlet and is held in place by a metal plate, which clamps it against the tile. This mat is so placed as to avoid the action of the chemicals in the tile upon the metal in the plates. If this were not done the plates would rapidly become disfigured. If a wall case is set in the tile two holes are drilled in the latter, using an ordinary twist drill, and the mat fastened to the tile with wood screws and screw anchors. The wall case is then fastened to the mat. Plaster of paris should be used when setting the box permanently, as this aids in securing it.

In ceiling outlets gas pipe generally exists in dwellings which are being wired. In this case a round, shallow box is put in place, a hole being made in the center of the box, the gas pipe protruding. It is pushed firmly against the plaster and a round ring with a setscrew in it placed over the gas pipe and pushed firmly against the inside of the box, being fastened by means of the setscrew. The plaster in all ceiling outlets should be cut to allow the box to set flush with the ceiling.

Where there is no gas pipe a hanger must be provided. It is made long enough to reach from the face of the box to within five inches of the flooring above the ceiling. Cleats should be nailed on the beams and the hanger so made as to be fastened to the cleats. This is shown in Fig. 7.

The conduit through which the feed wire will be drawn should be rigid and enter the box at the most convenient point. As this conduit will be of a much greater diameter than the flexible tubing it will necessarily have to be placed above the beams. The beams will have to be notched to allow the conduit to rest at a level with the top of the beams. As a great amount

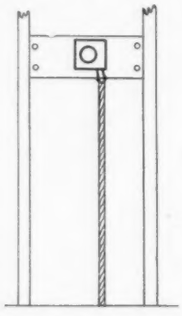


FIG. 6.—BOX IN POSITION.

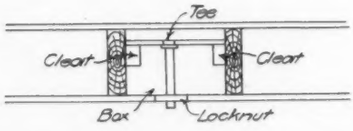


FIG. 7.—INSTALLING CEILING OUTLET.

of wood will be removed from the beams it is well to endeavor to run the conduit direct to the basement and continue it to the service board. The conduit can be fastened to the ceiling with pipe straps or by using a hanger if necessary.

If this is impracticable because of the construction of the building, flexible tubing can be used as in wiring for the circuits, using two or three tubes as the system requires and drawing one conductor in each tube if direct current is going to be used with absolutely no possibility of changing it to alternating. If the tubing which must be used to allow the necessary sized wire to enter is larger than the tubing used in the circuit work, it can be run over the beams. In this case a wider notch would have to be cut, but not being so deep, it would not weaken the beam as much as cutting for the rigid tubing.

Should alternating current be used two or three wires of equal carrying capacity should be drawn into each tube to avoid excessive heating of the conduit due to induction. This will involve a change from the standard type of service board, inasmuch as each wire entering each tube would have to be protected by a fuse and all fuses connected to one switch. As this would be an expensive plan, both in cost of copper and space, it should be resorted to only in extreme cases.

In the installation of flexible tubing it must be remembered that each additional bend means more work and time when drawing in the wire, and it is always the best plan to go from one outlet to another in as nearly a straight line as possible. This system of conduit should be permanently grounded as in the case of rigid conduit.

Resistance Calculations with the Slide Rule.

By STEPHEN E. WOODBURY.

Calculations with the slide rule involving the heating effects of the electric current are often solved directly by having the instrument arranged with the C scale adjacent to the A scale. A few cases are given in the following:

If the index of the inverted slide be set to a certain point on the D scale corresponding to the voltage, then under any value indicating the watts on the A scale, there can be read, by the aid of the runner, the corresponding value for ohms on the B-I scale. The decimal point in the result is located by the following method. If the runner lies across the rule between the middle indices of the A and B-I scales, the number of digits

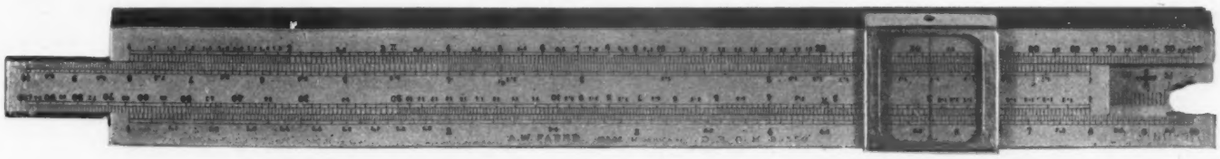


FIG. 1.—SLIDE SET FOR RESISTANCE CALCULATION.

in the result is equal to twice the number of digits in the value for volts less the number of digits in the value for watts. If the runner lies on either side of the space between the middle indices, the number of digits obtained above must be diminished by one if the slide projects to the right and increased by one if the slide projects to the left. In Fig. 1, the index of the inverted slide is set to 80 volts on the D scale. Opposite 320 as watts on the A scale can be read 20 as ohms on the B-I scale. When the runner lies outside of the space between the middle indices, as in this case, the plus and minus signs in the groove afford a reminder that a digit is to be added or subtracted according to which is visible, as explained above. It will be noted that the value for either the watts or the ohms may be taken on the A scale and the corresponding value for ohms or watts read on the B-I scale; and that the calculation may often be performed in either portion of the A and B-I scales, without affecting the method.

Another important application of the inverted slide rule is found in calculating the effects on the watts generated and the current flowing in a circuit when additional resistance is inserted in series. With the slide inverted and all indices coinciding, the left index of the C-I scale may be considered as 100 per cent in amperes, the left index of the B-I scale as 100 per cent in watts and the left index of the D scale as 100 per cent in ohms. At other points on the rule may be read, by the aid of the runner, the reduced per cent of amperes and watts corresponding to an increased per cent of ohms. For example, read opposite 45 per cent of total watts on the B-I scale 149 per cent of ohms on the D scale and, by the aid of the runner, 67 per cent of amperes on the C-I scale. This principle may also be applied for obtaining actual values. For example, what ohms are needed in series with a 20-ohm circuit to reduce the watts to 64 per cent of the former value? Setting the left index of the inverted slide to 20 ohms on the D scale, as in Fig. 2, read under 64 per cent of watts on the B-I scale, 25 ohms on the D scale, i. e., 5 ohms external resistance. In the above example, let the resistance of the circuit be changed to 90 ohms. In this case it is necessary to set the right index of the inverted slide to 90 ohms on the D scale, then, as in the first case, read under 64 per cent of watts on the B-I scale, 112.5 ohms on the D scale, i. e., 22.5 ohms external resistance. In each case there can be read, by the aid of the runner, over 64 per cent of watts on the B-I scale, 80 per cent of amperes on the C-I scale. If it is desired to find the actual watts developed at the reduced current the value 80 per cent of amperes on the C-I scale is set to the maximum watts on the A scale, say 320, when the reduced watts, 205, is read on the A scale at the index of the slide.

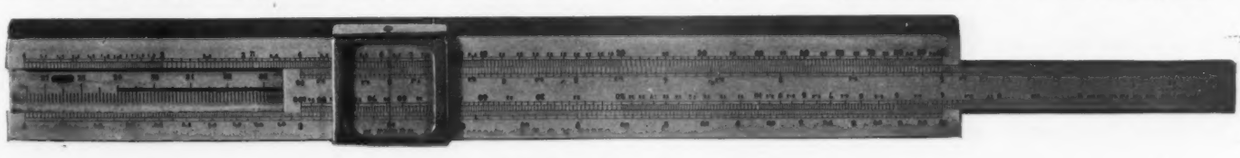


FIG. 2.—SLIDE SET FOR POWER CALCULATION.

Tendency of Design in Boiler Plants.

Mr. A. Bement presented a paper at the Chicago meeting of the Northwestern Electrical Association summarizing briefly the results of his experience in boiler and furnace design, which have been given from time to time in recent years before various technical societies and also published in the technical press.

The usual boiler does the largest portion of its work with the smaller portion of its surface; the horizontal water-tube type provided with two flame plates, insuring three passes of the gases across the tubes, does from 70 to 90 per cent of the work in the first pass, or in other words, with one-third of the boiler surface, while the other two-thirds, or 66 per cent, performs only from 10 to 30 per cent, and this performance applies to other types in corresponding measure. Thus the larger proportion of the investment is in that part of the apparatus which renders comparatively little service. One of the reasons why the boiler surface is not brought into more active service is that the proportions of the gas passages are such that the natural volume of the gases cannot fill them, therefore many corners and portions of the passes are not filled with hot gas, because the pass is larger than the mass of gas flowing through. Thus the work is performed along an exactly defined path over which the gas naturally flows, the most direct one from the furnace to the chimney.

For this reason it does not pay to use a large boiler as compared to a small one, unless with the larger, provision is made for as good utilization of the surface as secured with the smaller one. For example, one of the Heine type 11 tubes high is approximately of the same capacity as one 17 tubes high when equipped with the same sized grate, because the magnitude of the gas volume is the same from each, and it will be only that portion of the surface of the tubes over which this gas flows that will absorb heat, and the distance from the entrance to the exit of the tube surface is approximately the same for each. With the Babcock & Wilcox type, as much work could be obtained with a boiler 16 ft. long as now baffled, as in one of 18 ft., with the result of saving not only a small amount of investment required for boiler, but a large amount in land and buildings.

The truth of the foregoing has begun to be realized, and the tendency is for better proportioning of gas passes, so arranged as to insure the use of a larger portion of the boiler surface than under present practice. For illustration, the performance of three boilers of the Heine type will explain the matter. One of these boilers was equipped in the usual manner, allowing the gas to flow diagonally across the tubes directly to the exit.

while with the others, by means of additional baffles, the gas flowed twice the length of the tube surface in one case and three times in the other, all three boilers having the same size and kind of grate. The relative performance was as follows:

Heine type of boilers.	Relative work performed by boilers. Capacity.	Amount of steam per pound of coal.
With single flow of gas	1.00	1.00
With double flow of gas	1.04	1.10
With triple flow of gas	1.04	1.20

Up to a certain point the application of additional baffling will increase the capacity, owing to the fact that the amount of heat absorbed will be greater, but beyond this the reduction of draft due to the more restricted passages, will be sufficient to result in a decrease in capacity. To overcome this, special means for draft production are justified, and it has been considered possible, by means of proper baffling and a combination of forced and induced draft, to get twice the capacity from the same sized boiler as is now obtained, and do so with no loss in efficiency. Thus there is obtained a saving in investment cost of one-half the boiler plant, land and building, at an added expense of only the draft producing apparatus.

The setting for boilers is something which is now having special attention, as it is found that even the very best brick setting is very leaky, allowing the entrance of much cold air. As a remedy, steel jackets and reinforced concrete have been used, also the brick settings have been sealed by applying a tight cement covering over which canvas has been pasted and then painted.

Requirements for good furnace performance are that there should be an ample combustion chamber located between the grate and boiler, in which combustion shall be enabled to continue until completed. Also, that the coal shall be fed at as nearly a uniform rate as possible, and that the removal of ash be accomplished with a minimum disturbance of the fire.

The discussion on Mr. Bement's paper was principally on the matter of flue gas analysis. Mr. Bement gave the prices on continuous flue gas analysis recorders which run from about $300 up. However, he did not recommend the purchase of a continuous recording apparatus at the start by any central station. An Orsat gas analysis apparatus for analyzing individual samples can be purchased for $25. If after working with the Orsat apparatus for a while the manager concludes that a continuous record of flue gas performances is desirable, he can purchase the more expensive continuous recorders. It was frequently possible, however, to determine conditions which give the best economy with the Orsat apparatus so that the continuous recording apparatus might not be necessary. It is easier to produce uniform conditions with chain grate stokers than with hand firing and continuous recording apparatus is least necessary with such stokers because the analysis of individual samples soon determines the best conditions under which to work the stoker. With hand-fired boilers continuous recording apparatus may be more necessary.

The Purification of Lubricating Oil.—III.

By James L. Grant.

Fig. 13 illustrates a duplex filter in which oil is received into an auxiliary tank, 2 (from an oiling system, or poured in by hand), containing a removable screen. It is drawn out of this by the spigot shown, and falls into a funnel under it (that is also protected by a screen), and being forced to the bottom of the vertical pipe, 3, which is fitted with a cap at its lower end, it emerges through holes bored for this purpose into a bath of water kept warm by a coil of pipe into which steam is admitted. If too much water collects here, or it becomes too dirty for effective use, some of it is drawn off through the faucet, 4.

The washed oil now rises until it flows out of the valves, 5 and 6, into the filters, 7 and 8, which cause oil to pass through fine meshes that retain all foreign matter, and allow only clean oil to fall into the storage chambers beneath them, out of which it is drawn through 9 and 10. The valve, 11, is provided for drawing impurities out of the settling chamber. The gauge, 12, shows the amount of pure oil in the filter, while 13 indicates the oil and water in the settling chamber.

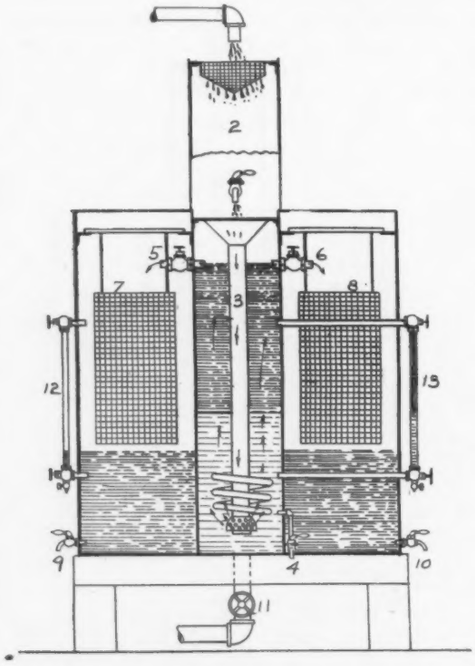


FIG. 13.—DUPLEX OIL FILTER.

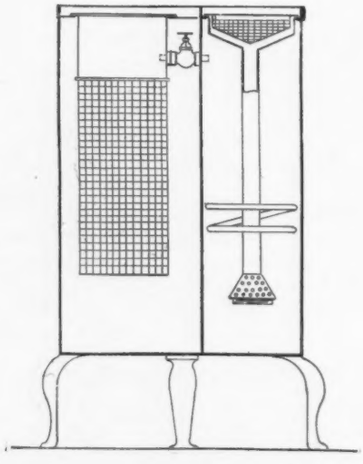


FIG. 14.—OIL FILTER SUITABLE FOR SMALL PLANTS.

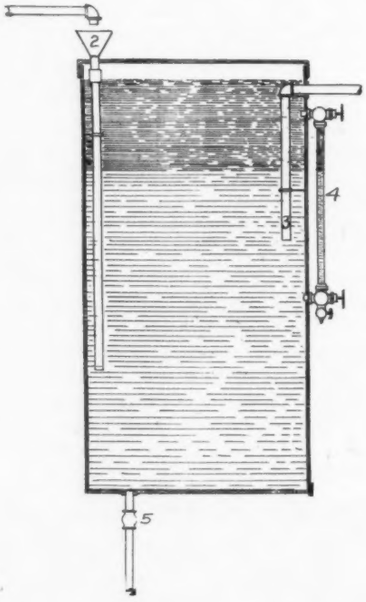


FIG. 15.—AUXILIARY OIL SEPARATING TANK.

Fig. 14 is practically the same as the preceding illustration, except that it is of the single type that is suitable for small plants only, as its storage capacity is small. As its filtering capacity is 20 gallons per day it will do the work required in a medium plant, but its storage capacity is suitable for a small plant only.

Fig. 15 is an auxiliary separating tank for use where oil is mixed with an excessive proportion of water. The mixture is

delivered into the funnel, 2, and the pipe carries it down far enough to avoid mixture with pure oil, contained in the upper part of it, after the tank has been used long enough to nearly fill it. When water falls to the bottom and oil rises to the top until the water line is above the lower end of 3, oil cannot enter

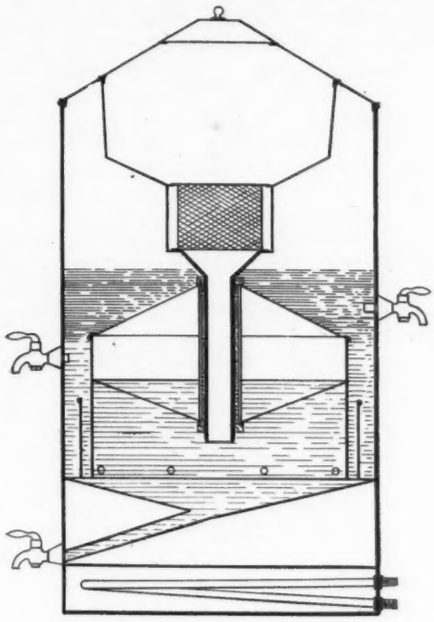


FIG. 16.—SINGLE CYLINDER OIL FILTER.

it, therefore after the tank is filled as illustrated, and more is poured in, only water will come out of the waste pipe, 3, but oil may be drawn out through a faucet tapped directly into the shell. When the water gauge, 4, indicates that the tank is nearly full of water, some of it may be drawn off through 5. Where water is drawn off from the lower part of any filter it is not a good idea to open the faucet wide because water that is running out of a tank rapidly through an outlet in the bottom forms a small whirlpool, and if oil is above it, some of this oil will be drawn into the vortex and wasted, although the faucet is below the true water level. The same result is secured (only in a less degree), if the faucet is located in the side of the filter. I have proved this several times by opening a faucet wide and securing a mixture of oil and water. After letting it remain closed a few minutes I have opened it to about one-quarter of its capacity and secured only water.

Fig. 16 illustrates a simple filter into which oil is poured at the top, is carried nearly to the bottom, and then returns to the upper part of the storage tank. On its way it passes through water and animal bone black, therefore it should be relieved of all impurities when it reaches the pure oil storage tank.

In some plants oil that comes to a filter is mixed with a large quantity of water, and although an ordinary filter is designed to separate a reasonable quantity of the two, it is not a good idea to expect too much of this service. Fig. 17 is a separator into which oil and water are discharged into the screen shown at the upper left hand part of the shell. This retains small pieces of waste, etc., and the water quickly finds its way to the bottom and passing under the separating partition, as indicated by the arrow at the lower right hand corner, rises to the overflow and goes to the sewer. This process may be continued indefinitely without interruption, but when the gauge glass indicates that the water level has fallen nearly to the lower edge of the separating partition, some of the oil should be drawn off at once. Of course it is better to keep the water level several inches higher than this point, not necessarily by drawing off water as that is discharged automatically, but by removing some of the oil. It is claimed that this separator will do so much of the work that a filter will purify 30 per cent more oil than it can without it. If a filter is to be worked up to its full capacity (as some of them are), it will pay to add this separator, but it will not be of much value in a comparatively small plant, where only a few gallons of oil are used per day.

Fig. 18 illustrates a filter fitted with a conical-shaped sieve in the receiving basin, which catches all coarse impurities, but allows the oil with all fine foreign matter to pass into the central cone-shaped receptacle that is filled with filtering material, which, of course, can be changed at pleasure by the engineer. It must pass to the lower end of this cone, from whence it emerges and floats upward through other filtering material into the oil chamber where it is ready for use. There is a coil of pipe in the lower part through which steam can be circulated for the purpose of heating the oil.

Fig. 19 is a more elaborate filter and its design shows much intelligent study of the subject of oil purification.

The oil to be cleansed is poured into the top of the filter where it passes through a conical sieve of fine mesh and is then conducted to a low point in the first distillation chamber, as indicated by the arrow. It passes around until it comes in contact with the partition of the second distillation chamber, through which it passes to an inner chamber. On its way thither it is skimmed twice by devices invented for this purpose. This chamber contains a cylinder wound with fine cloth through which the oil goes, but all remaining impurities are stopped.

The steam heating apparatus forming a part of this filter is an ingenious device. Steam enters at 2 and passing around the heating chamber is discharged into a siphon, 3, which causes air to rush in and mix with the steam. The mixture is then blown into the heating chamber through a perforated head, 4, which distributes the whole evenly. It is claimed that this mixture and distribution maintains an even temperature of the oil, which is an important part of the cleansing process. If the temperature of oil is raised to its boiling point its usefulness as a lubricant is greatly impaired or destroyed.

When the speed of steam engines averaged much less than it does at the present time, there was less need of oil filters, but high speeds demand perfect lubrication, which means a free use of oil, and as the great saving made by modern filters becomes apparent to engineers, the prejudice which formerly existed against the use of filtered oil rapidly disappears, until some engineers are not aware that it ever existed.

Of course it is possible to wear out the oil the same as almost

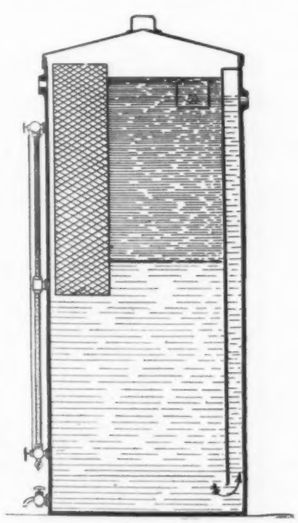


FIG. 17.—OIL SEPARATOR.

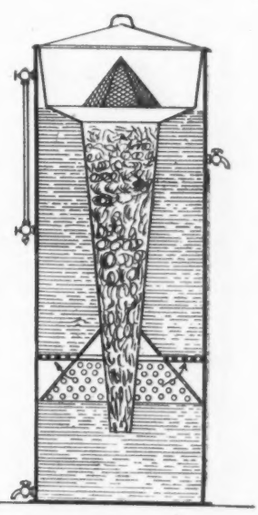


FIG. 18.—FILTER WITH CONE-SHAPED SIEVE.

everything else can be worn out, but unclean oil is frequently mistaken for oil that is worn out, although there is a vast difference between the two kinds or conditions.

Clean oil is at once recognized as of value, but the filtering process does not restore any of the qualities lost by repeated

use, as it only removes foreign matter that has mixed with the oil on its journey through the various bearings or by any other means.

Fig. 20 illustrates a unique filter, as it is designed to purify oil under heavy pressure, regardless of its quality or condition, and it will handle heavy oil while cold, also all light grades equally well. As shown in the illustration it is in working order, with water in the lower part and oil in the upper. Water under any desired pressure less than 200 lb. is admitted by the valve, 2, and this forces the oil upward into the smaller part, which contains a filtering tube. The desired pressure may be secured from the boiler, as under ordinary conditions condensation will take place fast enough to prevent steam from heating the filter.

The perforated filtering tube is first wound with cloth to keep the holes clear, after which the filtering material is wound around as shown. Oil is forced through this material into the tube in which it rises and goes out through the valve, 3, and the sight feed, 4, which is filled with water, thus allowing oil to go up in single drops or in a small stream. As it is under pressure it may be piped to any part of the building. While this filter can be used without heat, it is possible to admit steam through 5 and facilitate the process by heating the oil.

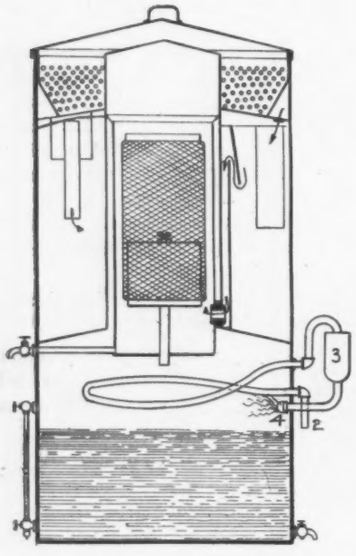


FIG. 19.—EFFICIENT OIL FILTER.

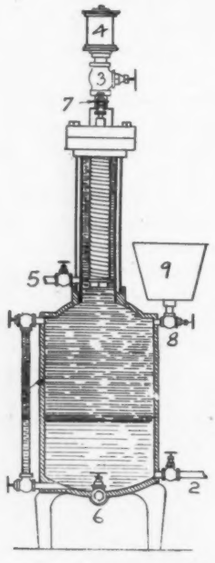


FIG. 20.—FILTER FOR OIL UNDER PRESSURE.

A glass gauge shows the amount of oil in the filter, and when it has all been forced out, pressure is shut off at 2 and all water allowed to run out at 6. The pet cock, 7, is opened to admit air. When all of the water has been disposed of, 6 is closed, 8 is opened, and more oil poured into 9. When the body of the filter is full of oil, 8 is closed and 2 opened slightly, until oil appears at 7, showing that all air has been forced out, when the pet cock should be closed and the filter is ready for full pressure at 2. It is safe to close 3 during the filling process to prevent water from leaving 4.

The fact that so many different kinds of filters are in successful operation, shows conclusively that the subject of oil purification is of great importance, also that it is receiving due attention from owners and operators of machinery of various kinds. While this condition of affairs is not always favorably viewed by oil dealers, still it is quite possible that if oil could not be filtered and used many times over, the excessive quantities demanded under such conditions would compel us to seek and use some other lubricant, the sale of which would be less profitable than oil now is, consequently the business might be much more unsatisfactory to all concerned.

Boiler Feed-Piping.

By R. T. Strohm.

THE steam boiler has most aptly been termed the lungs of a power plant. Such being the case, the most important point in the design of a boiler feeding system is that of reliability; that is, the system should be so arranged that at no time will it be necessary to shut down the boilers and draw the fires because of failure of the usual feeding device. This means that no boiler plant of any importance should be compelled to rely upon a single type of feeding device, but that, at the very least, two independent systems should be installed. Then, if one fails, the other may at once be put into operation, and the work of the plant carried on without interruption, while the necessary repairs are being made. The dangers of low water in boilers and the loss of prestige and money occasioned by the temporary disablement of a power plant are sufficient reasons for insuring against stoppage for any cause except accident to the plant itself, or the complete failure of the source of water supply.

This end is accomplished in a number of different ways. In a plant which uses a direct-acting steam pump to supply water to the boilers, an extra pump may be installed, the additional unit being so connected that it may be put into service at a moment's notice. Or, instead of an auxiliary pump, an injector may be connected to the feed line, so that it may be used whenever the pump is laid up for repairs. Or, again, both pumps may be installed, together with the injector, thus trebly guarding against failure of feed. It is apparent that numerous other combinations of devices can be made, depending on the methods and apparatus ordinarily used for feeding the boilers.

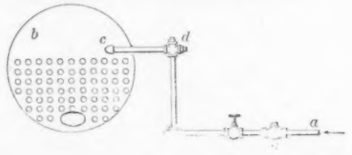


FIG. 1.—EXTERNAL FEED-PIPE FOR BOILER.

The feed-water piping system of a boiler consists of two distinct parts. That part which brings the water from the source of supply to the boiler and which lies wholly outside the boiler may be termed the external system; and that which conveys the water from the exterior to the point within the shell where the water is discharged may be termed the internal system.

The arrangement of the external feed system depends upon the kind, number and location of boilers used, and upon the number of auxiliary appliances by which the water is to be supplied in case the usual device fails.

The external feed system includes all the piping and heating and feeding devices between the end of the suction pipe and the end of the pipe that delivers the water to the boiler. The suction pipe, no matter whether a pump or an injector is used, must have air-tight joints, as any leakage of air on the suction side will impair the action of the feeding device, and may probably render it altogether inoperative, owing to the destroying of the vacuum in the suction pipe. The limit of lift by ordinary suction is theoretically 34 ft. in the case of water, but the conditions that arise in ordinary service are such that a lift of from 25 to 30 ft. is considered satisfactory. For the higher lifts, approximating the maximum of 34 ft., the pump and its attachments must be in excellent order. In case an injector is used the connections should be as free from bends as possible, so that the resistance will be reduced to a minimum.

The external feed system for a single return tubular boiler is shown in Fig. 1. The feed pipe, *a*, is connected to the boiler, *b*, by the pipes and fittings indicated, the feed entering the boiler at *c*. It will be observed that crosses are used at *d* and *e*, the openings opposite the pipes being closed by plugs. Should these pipes become clogged with sediment and sludge contained in the feed water, the plugs may be removed and the

pipes thoroughly cleaned by pushing an iron bar through them.

On the feed line, *a*, are two valves, *f* and *g*, the former being a globe stop valve and the latter a check valve. The check valve, *g*, allows water to pass through to the boiler on the discharge stroke of the pump, but prevents any return from the boiler. The stop valve, *f*, may be used to throttle the feed to

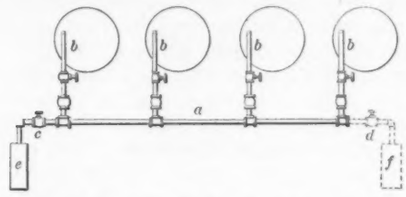


FIG. 2.—FEED PIPING FOR SEVERAL BOILERS.

the boiler or to cut it off entirely. Also, it is closed to prevent water from being discharged from the boiler when it becomes necessary to remove the check valve from the feed line for repairs. Hence, the stop valve should be placed between the boiler and the check valve. Should the stop valve also fail it is necessary to close down the boiler to repair the valves. To obviate this some engineers have added a second stop valve, which is always left open, except when the feed and check valves give out.

In case there are several boilers to be fed by one pump, the arrangement shown by solid lines in Fig. 2 may be used. The feed main, *a*, runs along the fronts of the boilers and has a branch, *b*, leading to each unit. On each branch are the usual stop and check valves. If it is desired to feed the boilers by either or both of two pumps, the arrangement shown in full and dotted lines may be used. Two stop valves, *c* and *d*, are placed in the feed main, just beyond each pump. Then, if the pump, *e*, is to be used alone, the valve, *d*, is closed, and if the pump, *f*, is to be used, the valve, *c*, is closed, while both valves are left wide open when both pumps are in use.

The accumulation of precipitates and mud in the feed-water heater makes it imperative that the heater be cleaned at intervals. Or, an accident may necessitate its being cut out of service. Consequently, it should have a by-pass, in order that there may be no interruption in the regularity of feeding of the boilers. In Fig. 3 is illustrated the arrangement of the by-pass connections. When the heater is in service the feed water from the pump enters through the pipe, *a*, and the valve, *b*, and leaves through the valve, *c*, and the pipe, *d*, the valve, *e*, being closed. When it becomes necessary to put the heater out of commission, the valves, *b* and *c*, are closed, and the

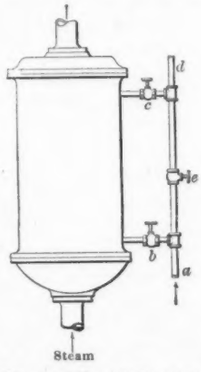


FIG. 3.—BY-PASSED HEATER.

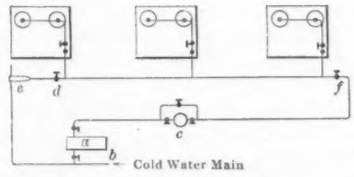


FIG. 4.—DUPLICATE FEED-WATER CONNECTIONS.

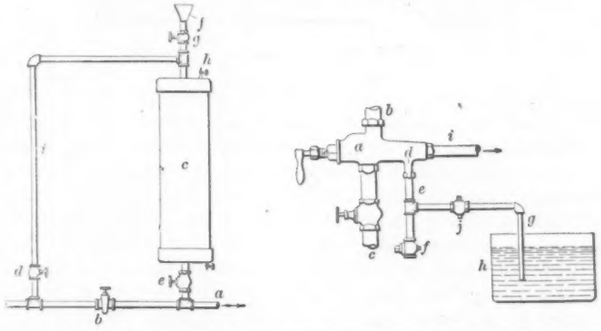
valve, *e*, is opened. Of course, if the feed-water heating apparatus is in duplicate, as it is in many plants, there need be no interruption in the feeding of hot water when one heater is laid up for overhauling.

Mention has already been made of duplicate means of supplying feed water, a combination of pump and injector being the usual way. The feed piping of a plant in which either the injector or the pump may be used is indicated in Fig. 4. The pump, *a*, may draw water from the main, *b*, and force it through the heater, *c*, to the boilers, the valve, *d*, being closed. When it becomes necessary to use the injector, *e*, the valve, *d*, is opened, and *f* is closed, the injector drawing its supply from the main, *b*. In this diagram the heater is placed between the pump and the boilers, and hence must be a closed heater, and subjected to full boiler pressure.

When an open heater is used it is manifestly impossible to place it between the pump and the boilers, since it cannot be subjected to pressure. Instead it must be placed on the inlet side of the pump. Now, a pump will not lift hot water to any great distance by suction. As a consequence it becomes necessary to place the heater above the level of the pump, so that the hot water may flow to the latter by gravity.

Although a number of boilers in a battery may be discharging steam into a common main and therefore be under the same working pressure, it does not follow that each boiler is doing the same amount of work. The variation in the condition of the fires in the several furnaces will influence the rate of evaporation, so that the rate of feeding the boilers will need to be varied according to the amount of steam each is generating.

This feed regulation is accomplished by means of the stop



FIGS. 5 AND 6.—APPARATUS FOR INTRODUCING BOILER COMPOUNDS.

valves placed in the branch pipes leading from the feed main to the boilers. By changing the amount of opening through each of these valves, the feed can be regulated so as to maintain the desired water level in each boiler. If the check valves are so made that their lifts are adjustable, the feed may be regulated by them, the lift of each being proportioned to the rate of evaporation of the boiler to which it is attached, the stop valves being left wide open.

Feed water is seldom so free from dissolved salts and other foreign matter that it can be used without some treatment for the prevention of scale in the boiler. Where it is possible to do so, the purification should occur before the water is fed to the boiler. But this is not always convenient, and it is customary in many places to introduce the scale solvent or boiler compound into the boiler with the feed water.

When a pump is used for boiler feeding the compound may be introduced by the use of the apparatus illustrated in Fig. 5. The pipe, *a*, is the feed line to the boilers, and it contains a gate valve, *b*. On either side of this valve are tees by which the vessel, *c*, is connected with the feed pipe. The valves, *d* and *e*, are used to cut off all communication between *a* and *c*.

The vessel, *c*, contains the solvent to be sent to the boiler. It is poured into the vessel through the funnel, *f*, and the valve, *g*, the pet cock, *h*, being opened during the filling operation, to permit the escape of air, and the valves, *d* and *e*, being closed. When the vessel, *c*, is full, the cock, *h*, is closed, as well as the valve, *g*, and valves *d* and *e* are opened. Afterward, the stop valve, *b*, is closed. The result is that the pump forces the feed water up through the pipe, *i*, thence into the chamber, *c*, sweeping out the boiler compound, and carrying it along through the valve, *e*, into the feed pipe, and thence to the boiler.

It is evident that by this method the entire contents of the vessel, *c*, is discharged into the boiler within a few seconds.

The ideal way of feeding a compound is in small amounts, at a regular rate. Such a method of feeding may be approximated with the device shown in Fig. 5, by opening the valve, *e*, but slightly, and regulating the amount of opening of the valves *b* and *d*, so as to cause a steady flow from the vessel, *c*, to the feed pipe.

A method of feeding boiler compounds by means of an injector is illustrated in Fig. 6. The injector, *a*, is attached to the steam pipe, *b*, and the cold water pipe, *c*, in the usual manner. To the overflow, *d*, however, a pipe, *e*, is attached, the overflow valve being previously removed. On the pipe, *e*, is a tee, one branch of which leads to a cock, *f*, the other being connected to the pipe, *g*, leading to the tank, *h*.

The boiler compound is contained in the tank. To cause it to be fed into the pipe, *i*, the cock, *f*, is opened, and *j* is closed, and the injector is started in the usual manner. After it is started a flat piece of packing or of leather is placed over the lower end of the cock, *f*, preventing the admission of air. At the same time the cock, *j*, is opened, and the suction in the

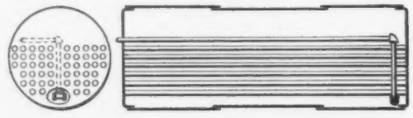


FIG. 7.—INTERNAL FEED SYSTEM.

pipe, *e*, will draw the compound from the tank, *h*, into the discharge of the injector, and it will then pass on to the boiler.

It will be observed that, in both of the methods used in Figs. 5 and 6, the solution containing the compound does not pass through the pump or the injector. Thus there is no possibility of causing damage to either by the action of the compound. Soda ash is very largely used as a scale solvent, and it has been found that pump packings are destroyed by soda ash liquor passed through the pump, this being due to the action of the compound on the oil contained in the packing.

The internal feed system of a steam boiler must serve a double purpose, in that it must not only convey the feed water to the point where it is to be discharged, but it must also permit the feed water to attain the temperature of the water in the boiler before allowing it to be discharged.

Since it is not improbable that cold water will be fed to the boiler at times, as, for example, when the feed-water heater is by-passed, it is well to have the feed pipe discharge into the coolest part of the water space. This, in the ordinary tubular boiler, is at the rear, near the bottom. Again, the feed pipe should be so located that it will be easily accessible for repairs.

Taking all these points into consideration, it will be found that a very convenient arrangement of the internal feed system is that shown in Fig. 7. The feed pipe enters the front head near the shell, above the upper row of tubes, and below the water level. It is then carried to the rear, where it turns, at right angles, to the middle of the boiler. Then, by means of another elbow, it is extended downward between the two central rows of tubes, and fitted with a tee at the lower end. In this way the water inside the feed pipe is heated by the water in the boiler, and the fresh feed is discharged at a temperature so nearly that of the boiler water that there can be no danger to the boiler materials. The tee aids in diffusing the feed at the point of discharge.

Of course, there are many other ways of arranging the internal feed system that may prove satisfactory. Some water-tube boilers discharge the feed water into an open drum suspended in the water space, thus compelling the fresh water to attain the boiler temperature before coming into contact with tubes or plates. Other water-tube boilers feed through a mud drum. In some cases feeding into the steam space has been successfully done, the water being sprayed in thin sheets into the steam. This method, however, does not seem to have met with any very general adoption, it being commonly considered best to feed into the water space.

Bearings and Their Lubrication.

By Francis H. Davies.

In any bearing the function of the lubricant is to convert rubbing into rolling friction by the intervention of the minute globules of which the lubricant is composed; consequently, in a well-lubricated bearing, the metallic surfaces never actually touch one another, but are separated by a film of oil, more or less thick according to its quality and the amount used. In the case of a bearing which is loaded in a downward direction, say to a pressure of 10 lbs. per square inch of area, it is obvious that the oil between the lower surfaces has to transmit an equivalent force in order to keep them apart, and it therefore follows that oil cannot be fed between these surfaces unless it is supplied at the above pressure. Now the case in point is that of an ordinary bearing fed at the top by a drip lubricator having no mechanical arrangement to put pressure upon the oil; and the question is, how does the latter get between the lower surfaces where the oil is under a pressure of 10 lbs. per square inch?

The result is brought about by the property of adhesion in conjunction with the velocity with which the oil is carried round by the shaft. In the above case the shaft naturally lies on the bottom surface of the bearing, leaving a small but important crescent-shaped space at the top. The oil from the lubricator falls into this space and spreads itself thickly over the upper surface of the shaft, adhering to it; the film between the bottom surfaces is of course much thinner. As the shaft rotates the freshly fed oil is carried into the gradually narrowing space, acquiring a high velocity, and by its adhesive properties still clinging to the journal. It is now, of course, considerably compressed and the farther it is carried the greater its pressure becomes, until finally it acquires a pressure equal to that between the lower surfaces.

The ordinary rotary or main bearing where the pressure is constantly in one direction is always fed at the top, but in a reciprocating bearing such as that of a connecting rod top or bottom end, feeding from the side is most usual, at any rate in large units. In such a bearing the crescent-shaped space naturally attains its maximum alternately at the top and bottom, and oil being fed in at the side also flows into this space as being the path of least resistance. So, as the stresses alternate, the oil is partly forced from top to bottom or vice versa, leakage being made up by the supply from the sides. At the feeding point it is necessary to cut the "brass" away a little in a gradually diminishing curve so as to allow the oil room to spread over the pin. Cross-head guides or any sliding bearing should be gently sloped away at the ends in order, as it were, to give the lubricant a start; and the oil should be supplied at the top, where the guide is vertical or at an angle, and at the center where it is horizontal or very nearly so.

The question of lubricating oils is a very important one, and by far too large a subject to be more than touched on here. The chief points to be considered in the selection of an oil are the pressure on the bearing or the size of the engine and the temperature at which it is presumed the part to be lubricated will work. What is wanted is a fluid that possesses the lowest molecular friction, and from this point of view the thinner the oil the better. On the other hand, thin oil does not lend itself very well to what may be termed the adhesive action of the bearing, and as the latter heats up it gets thinner, and consequently worse and worse in this respect. On the contrary, thick or heavy oil owing to its greater adhesiveness, will force its way in even against the greatest pressure, but when there it is not so efficient as thin oil. It is obvious that in a case like this the idea is the happy medium, and it is at this result that most manufacturers of oils aim. In an engine or any machine it is customary to use the same oil to lubricate all the external parts; but it should be remembered that while this is the only method possible in practice, it is theoretically wrong, as recipro-

cating bearings require a heavier oil than guides or journals in order to reduce as much as possible the flow from top to bottom of the "brass" consequent upon the alternating impacts. It is conceivable that a greater proportion of a thin oil would be forced round to the side where there is no load than would be the case where a thick oil with its superior viscosity is used.

It may be taken as an axiom that so long as rolling friction only, as defined above, is present in a bearing there will be no appreciable heating; but the moment rubbing friction between metal and metal occurs warming up begins. This may be due to three causes: (1) insufficient supply or poor quality of oil, (2) the presence of a foreign substance such as grit in the bearing, or (3) badly prepared surfaces. In the first case rubbing friction will occur all around with disastrous results in a very short time; the shaft or pin expands with the heat, making matters worse, and finally becomes such a tight fit that the engine pulls up or something breaks. In the second case rubbing friction is only set up in the small area affected by the grit; but the heat generated there soon spreads, causing the bearing to close up as before, and the result will be bad scoring of the "brass," particularly in the place where the grit is present.

The third case is, primarily, similar to the second, but will be aggravated in results, since instead of rubbing friction being set up only at one point, it will occur more or less all over; that is, at every part where the "brass" or shaft surface is uneven or scored.

Another point to be remembered in regard to hot bearings is that above a certain temperature the oil chars, losing its lubricating properties. When this stage is reached, under ordinary systems of lubrication no amount of oil will cool a bearing, and the engine must be shut down.

When a bad hot bearing occurs it is certain that some part of the surfaces will suffer injury, and for obvious reasons it is most important that this should not be the shaft. If a bearing is composed of iron or brass, the result of heating will be both a scored shaft and bearing; but if the latter is made of some considerably softer metal such as an alloy of tin, and also antimony (genuine babbitt) or one of the cheaper alloys containing also lead, it alone will suffer. For this reason in work of any size the principal bearings are always lined with some "white metal," which varies much in composition, but always contains one or more of the above ingredients, or others such as zinc, copper, aluminum. In the selection of bearing metal a point to be considered is the corrosive action of the oil, which varies greatly according to the metal. Tin and antimony are not attacked at all by oil, copper slightly, and lead and zinc considerably; it therefore follows that from the point of view of durability the first metal should form the base of the compound. The desired amount of hardness must, of course, vary with the work on the bearing; but the softer the "brass" the better in order to reduce the labor and cost of surfacing.

The re-babbitting of bearings is a frequent operation in large installations and fortunately it is a simple matter. The brass or iron shell is generally provided with grooves or holes to key the metal in, and in addition it is often desirable to tin the surface in order that it shall adhere. Lead in a bearing alloy causes it to adhere readily to the tinning, and also by its nature reduces the contraction of the metal when cooling to a minimum. If the contraction is too great the alloy cannot properly unite with the tinned surface.

In re-babbitting the shell should be fitted with a mandrel slightly smaller than the shaft; this and the shell should be heated, before being placed in position, and the babbitt metal then poured through a hole, the alloy being "teazed" all the time with an iron rod to insure perfect spreading. Large bearings should be cast vertically, but small ones may be fed through a hole in the top. When cold it is necessary to ascertain whether the metal has adhered to the shell all around, and this can be determined by tapping with a hammer. If it sounds hollow in one place a piece of iron of approximately the same size as the shaft should be laid on the surface and struck with a sledge in order to expand the metal and make it uniformly solid.

It is the usual practice to hit the surface all over with a hand hammer, but this is not to be recommended as it makes the metal flakey and liable to crack. After this operation the two halves are chucked together and most of the superfluous metal taken off in a lathe. Then follows the process of surfacing, performed in the usual manner with a scraper. The shaft or pin is thinly painted with red lead and the brass is put in position and rotated a few times, with the result that the red lead adheres to the high places and clearly indicates their position. These are now scraped down and the process repeated until the bearing after having been applied to the shaft shows a uniform distribution of the paint all over, indicating, apparently, that it touches everywhere. But this is never actually the case, and the inaccurate result is due to the somewhat primitive method followed. However carefully the operation may be conducted, the scraping cannot be made absolutely even; nor is there any true polish such as is necessary for good running. It remains, therefore, for the engine to finish the task, and after a short run all inequalities will have been worn away and the proper amount of polish acquired.

It should be noted here that it is quite as possible for a reciprocating bearing to run hot through being too slack as through being too tight. A very slack bearing will knock heavily and the impacts of the surfaces will naturally evolve heat. In practical working when such a case occurs the only remedy short of tightening the bearing, is to keep it over supplied with oil, thus producing a cushion for the blow.

It is customary in large bearings to cut grooves in the surfaces in order to allow the oil to flow readily to all parts; but in some quarters this practice is condemned, because grooves tend to drain the bearing and interfere with its pumping action. This is quite true if the grooves are not properly designed, and for that reason they should not extend right along the surface, but, commencing at the point of oil delivery, should proceed outward and return in an opposite spiral. This precaution will obviate any tendency to draining.

Guides do not need grooves if the surfaces are properly prepared; and they are certainly undesirable in bearings of reciprocating machines where it is so essential to keep as much oil between the loaded surfaces as possible. In this case the channels only aid it to pass to the unloaded side where it is not needed. Where grooves are used it is important that the edges should be rounded, for if they are left sharp they tend to wipe off the oil and keep it all in the channels.

It is well known that, up to certain limits, the greater the load on a bearing the longer it should be, in order to distribute the pressure over as much surface as possible. In such bearings it is essential that besides being exactly concentric, they should also be accurately in line; not at all an easy matter to arrange. To meet this difficulty, what are termed spherical bearings are sometimes used; that is to say, the center of the underneath brass is enlarged into a nearly spherical shape and seated on a white metal bed on the top of the pedestal. The two brasses are then bolted together and kept approximately in position by a cast-iron case. It is evident that such a bearing is capable of restricted movement in all directions, so that should the shaft be slightly sprung, the bearing will move on its seat an amount sufficient to compensate for it. Such an arrangement is often adopted on large dynamos, and is extremely useful, saving a lot of trouble. A point to be remembered in connection with this bearing is that the closer approximation the central enlargement makes to the true sphere the better its action.

In conclusion it may be well to point out a very common error in regard to the friction losses in rotary bearings. It is a prevalent but quite mistaken idea that these losses are directly proportional to the load or pressure on the bearings; if the matter is properly looked into it becomes obvious that such is not the case. Given efficient lubrication under all loads, there is always a film of oil between the bearing surfaces; therefore, as these surfaces do not touch there is no actual friction between them at any load, and the loss of energy known as friction is due solely to the tangential stresses in the lubricant.

LETTERS ON PRACTICAL SUBJECTS.

SOME EXPERIENCES IN AN ISOLATED PLANT.

Some time ago a four-pole, 30-kw, 220-volt, compound-wound, direct-current dynamo was installed in an isolated plant in this town. When started this machine operated fairly well until the load became quite heavy, when it was found difficult to keep up the voltage. Since this was the only machine installed at the time, three wires were run to the switchboard, namely, the positive, negative and one to the field rheostat. The cause of the drop in voltage was thought at first to have been due to a slippage, either of the belts or the pulleys, as a number were used between the main shaft and the dynamo. Investigation showed, however, that the trouble was not in the belts or pulleys, but was due to the fact that the series coils on the machine were not in circuit at all, since the positive lead to the switchboard was connected to the equalizer terminal instead of the end terminal

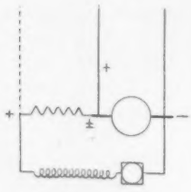


FIG. 1.

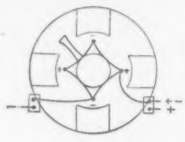


FIG. 2.

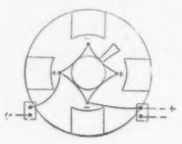


FIG. 3.

of the series winding, as shown in Fig. 1. Changing this lead to the end of the series winding, as shown by the dotted line in Fig. 1, put the series coils in circuit and the machine held its voltage nicely.

Some time later it became necessary to true the commutator, which necessitated the removal of the armature from the machine as the work was done in a lathe some distance away. The job took more time than was thought would be required, and as night drew near considerable haste was made in replacing the armature and assembling the machine, and as usual, something went wrong. When started the machine failed to generate, and there was considerable confusion among those present. Finally the attendant, remembering some directions he had seen somewhere, proposed reversing the shunt field connections, which was done, and the machine built up all right. But, when the load came on—which was very soon—how differently the machine acted, and every one thought that some harm had been done to the armature while in the lathe. The machine was run for some weeks, but the service was so unsatisfactory that it was necessary to locate and remedy the trouble. Now, it appears that the yoke carrying the brushes was capable of a movement through an angle of 180°, and before the machine was taken apart the yoke handle stood at an angle of 45° to the left of the vertical, as shown in Fig. 2. When the machine was assembled no one thought of the position of the yoke and it happened that it was placed 90° ahead of its former position, so that the handle stood 45° on the right of the vertical, as shown in Fig. 3. This, of course, placed the brushes in positions of opposite polarity and the current generated circulated in the shunt winding so as to oppose the residual magnetism instead of assisting it, with the result that the machine could not build up. Reversing the shunt leads remedied the trouble, but since the polarity of the brushes was reversed, the current circulated in the reverse direction through the series coils and external circuit, with the result that the series coils opposed the shunt coils, the voltage dropped more and the machine sparked worse than when operated as a plain shunt machine. The trouble was brought to my notice and remedied by simply shifting the yoke back through 90° and reversing the shunt leads, when the machine worked nicely and without hardly a sign of sparking.

After some time the capacity of the plant was considerably increased and motors installed for power service. A new switchboard was installed of sufficient size for four dynamos and a large number of lamp and motor feeders. Ordinarily the lamp and motor circuits were put on separate machines, but at times all the machines were operated on the entire load. The switchboard was designed so that any combination of machines could be operated in parallel on either the motor or lamp busses or both. The switchboard was added to as the number of machines was increased, and arranged as shown in Fig. 4. Occasionally machine No. 4, when operated in parallel with some other machine on the motor bus, would mysteriously reverse its polarity and this generally occurred when shutting down, as it was the practice to reduce the excitation of the machine until the ammeter showed little current, and then open the triple pole switch. Several opinions were given as to the cause of the reversal of the polarity, but no attempt was made to remedy it until after the last new machine was installed. When it was attempted to operate No. 4 in parallel with the newest machine, which is No. 1 in the diagram, No. 4 would motor heavily and the fuses and circuit-breakers would blow. This action was aggravated by a deceptive ammeter indication in the circuit of No. 1. An investigation was made and it was found that the equalizer in the motor bus had not been carried to No. 4, as shown by the dotted line in Fig. 4, and all this time the machines had been operated in different combinations, although the operation of No. 4 was at times somewhat erratic. Continuing the equalizer to No. 4 cured the reversal of polarity.

When the last and newest machine was started it ran well enough alone, but when put in parallel with the others a curious action of all the ammeters was noticed, especially when cutting this machine (No. 1) out of circuit. None of these actions were noticed, however, when No. 1 was not running. In reducing the excitation of No. 1 its ammeter reading could not be reduced below a certain amount and before cutting the machine out the sum total of the ammeter readings was great compared to the readings after No. 1 was cut out, and there was no change in the load. This action was brought to my notice

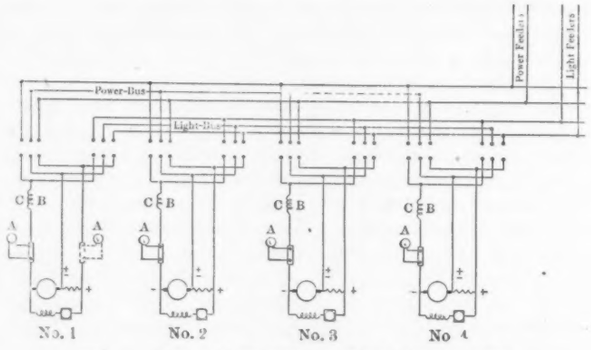


FIG. 4.—DIAGRAM OF SWITCHBOARD CONNECTIONS.

and I surmised that it was due to the ammeter being connected in the wrong lead from the machine and an investigation proved this to be the case. This condition is shown by the dotted shunt and ammeter in the positive lead of No. 1 (Fig. 4), and after the shunt was placed in the negative and opposite lead the trouble was cured and all the machines worked well ever since.

Patchogue, L. I. Henry Mulford.

SOME QUICK PIPE REPAIRS.

A six-inch steam pipe failed in one of the pieces, a crack having developed half way around one of the flanges at the junction with the pipe. A piece of flanged cast-iron pipe about 6 ft. long had to be removed, and a new length of pipe ordered. Meanwhile the plant had to be kept running and temporary repairs quickly made. The pipe was cut off by a 12-in. hack-saw as close to the crack as possible, and the end filed up smooth and square. It was then found to be just two inches short. Two blank flanges were then drilled to fit the flanges in the pipe line and three jackets were procured, two of them being placed between the extra flanges and the flange of the old pipe in the

line, and the other was placed on the top of the two extra jackets and the cut-off end of the broken pipe was placed against the new jacket mentioned. A set of bolts long enough to pass through the remaining flange on the broken pipe and its companion flange in the line, also through the two new flanges and their jackets and through the fixed flange at the other end of the break in the steam line, was procured. The cut-off end of the broken pipe was carefully adjusted so as to be central with the extra flanges and jackets, and while held fast in that position the nuts were screwed up on the long bolts, and the broken piece of pipe together with the extra flanges and jackets, clamped firmly together. So well did this arrangement work that after the new piece of pipe arrived it was not put in position, the long bolts holding the pipe line for many years. In fact, the writer has since frequently erected permanent piping in that manner.

WILLOUGHBY, OHIO. HENRY JOSTES.

FAULTS IN NEW ELECTRICAL MACHINERY.

Upon leaving the test room, electrical machinery is supposed to be in proper condition for service; but such is not always the case, as the following incidents show: A 150-hp direct-current motor, after receiving the usual tests, was shipped and duly installed, but after running about two weeks the circuit-breaker blew out and the motor refused to move thereafter.

I was sent to see what the trouble was and an examination showed it to be apparently in as good shape as when shipped from the factory, there being no visible evidence whatever of any trouble. When I attempted to start it, however, the circuit-breaker would blow out, the armature refusing to move. The motor was belted to an air compressor and I removed the belt and turned the armature over a few times by hand, to make sure that it turned freely, and finding it did so I tried to start the motor again, and upon closing the switch the armature began to revolve, but after making about ¼ of a revolution it stopped abruptly and the circuit-breaker blew out. I made repeated trials, but with the same result, the armature refusing to make more than ¼ of a revolution. I then began testing to locate the trouble and found a heavy ground in the armature. As there was still no evidence of the exact location of the trouble, I proceeded to disconnect the armature winding from the commutator, and after disconnecting some 25 or 30 coils I found that the trouble was in the commutator, and binding some wire tightly around the commutator to hold it together I took out the bolts and removed the front shell when the trouble was immediately in evidence; the inside of the commutator being burned and smoked very badly. The commutator had become grounded in the back shell at the points of the segments (Fig. 1) and as the motor was running on a railway circuit and the frame of the motor was grounded the result was disastrous. It being necessary to clean the entire inside of the commutator I replaced the front shell and disconnecting all the winding, removed the commutator from the shaft. Requiring to be held together very firmly while the shells were removed, I went to a planing mill and had two pieces of hard wood 30 by 14 in. cut out of 4-in. plank and out of each had a half circle sawed so that when the two pieces were clamped together the result was a circle 1/16 less in diameter than the diameter of the commutator, as shown in Fig. 2. Two holes were bored for ¾-in. bolts and the two pieces were bolted onto the commutator very tightly, and these held it together as firmly as the shells had. I then removed the shells and made the necessary repairs, the commutator being burned so badly that it was necessary to scrape every bit of the inside in order to remove the charred insulation and melted copper and a new mica ring was also put in the back shell. After thoroughly repairing and replacing the commutator on the armature the motor ran all right again. The fact that the commutator was practically air-tight accounted for the fact that there was no external evidence of the burn-out.

Some time later a somewhat similar burn, but much less severe, was repaired by simply removing the front shell and disconnecting the burned segments, removing them and after repairing the burned insulation, replacing the segments. This can be done if the burn-out is not too severe, and especially if the shells are in sections, which is now the usual practice in machines of any size. This method, however, generally necessitates the turning of the commutator afterwards, as it is almost impossible to get the segments replaced without leaving high spots.

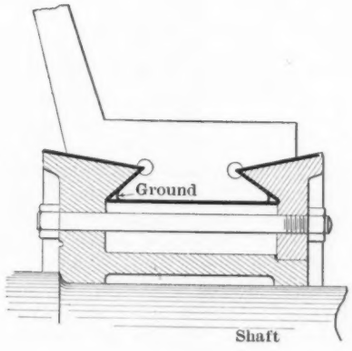


FIG. 1.—GROUNDED ARMATURE.

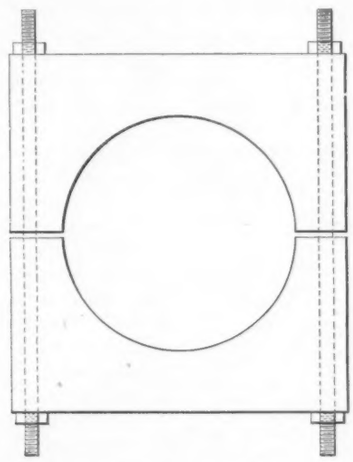


FIG. 2.—SKETCH OF WOODEN CLAMP FOR COMMUTATOR.

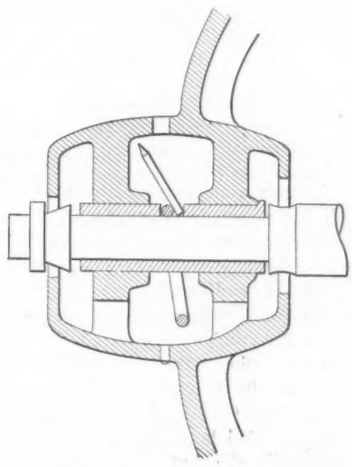


FIG. 3.—SINGLE OIL RING BEARING.

A new motor after being installed ran well for about two months, when it suddenly developed a hot bearing and melted the babbitt before the motor could be stopped. Luckily this happened in a machine shop and the attendant had sufficient presence of mind to slip off the belt and keep the armature turning over slowly by hand until the babbitt was cooled. In melting, the babbitt ran into the oil groove on the shaft and it was necessary to force the bearing off the shaft with a jack. As there was a good supply of oil in the oil chamber and the motor was in a clean place it seemed strange that the bearing should heat so quickly and without apparent cause, but when the bearing was removed from the oil chamber the cause of the trouble was apparent. The bearing was supplied with oil by a single oil ring and lodged between this ring and the bearing in such a manner as to prevent the ring from turning was a lead pencil, as indicated in Fig. 3. Upon removing the lead pencil it was found to bear the name of the company that made the motor, and in all likelihood the man in the test room used the pencil to ascertain whether the oil ring was working properly and accidentally dropped it into the oil chamber and left it to its fate.

The bearing was repaired and gave no further trouble, and in due time the maker of the motor was called upon to pay the bill for repairs and did so without any further question when the pencil was submitted as evidence.

A motor-generator set consisting of an 800-hp, 11,000-volt synchronous motor with a 300-kw, 175-volt, direct-current generator on each end was installed and put in service in apparent perfect condition. For a few days all went well, but gradually the temperature of the bearings began to rise and the oil to turn a dirty color. The oil chambers were drained of oil and thoroughly cleaned and refilled with new oil and all went well again for a short time when there was a recurrence of the same trouble. Finally the bearings were removed and scraped and new oil again used, but in a short time the same trouble resulted. This trouble continued without apparent cause or abatement when one day the attendant happened to notice a minute spark between the shaft and the bearing. This was at once investigated to see if the cause could be discovered and also whether this was causing the hot bearings and blackened oil. A 200-amp. series ammeter was connected by suitable leads from under a bolt head on the bearing cap to a brush resting on the shaft and a reading of over 200 amp. was obtained as the needle traveled clear across the scale and against the side of the instrument.

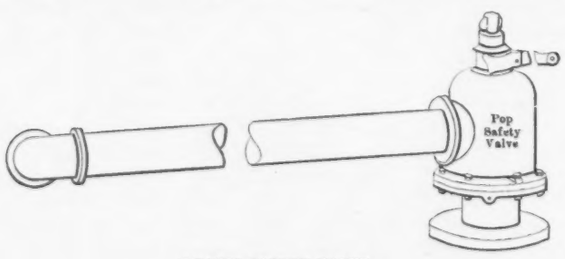
As the machine was clear of grounds this current was obviously an induced current of low voltage and high amperage flowing through a circuit formed of the frame, bearings and shaft of the machine and was undoubtedly the cause of the heating and the blackened oil, the deterioration of the oil being caused by the carbonizing effect of the current. As a remedy, sheet fibre of uniform thickness was inserted under each of the pedestals and the bolts were insulated in order to interrupt the path of the current. Thereafter the bearings gave no further trouble.

Niagara Falls, N. Y. E. C. Channing.

LEAKY SAFETY VALVE.

A certain steam boiler was fitted with a pop safety valve which continually gave trouble by sticking and failing to work in as sensitive a manner as desired. Many times the valve was taken down, closely examined and found to be apparently in first-class condition, only to stick as soon as steam was again up to the blowing-off point. After many weeks of mysterious action the trouble disappeared as suddenly as it came, and there was no further difficulty. After a time it was decided that the cause of the trouble was due to the pipe which carried the steam from the valve to the outside of the boiler house. This pipe extended horizontally about ten feet, passing through an opening in the wall of the boiler house, then terminating in an elbow, which discharged horizontally.

The trouble was caused by the pressure exerted on the end of the ten-foot escape pipe; the reaction of the steam issuing



LEAKY SAFETY VALVE.

from the elbow, at right angles to the length of pipe, causing sufficient force, which being imparted to the valve through the medium of a ten-foot lever, served to strain the casing of the valve sufficiently to cause the trouble mentioned above. Some changes in the piping caused the elbow to be removed from the end of the escape pipe, when, to the astonishment and delight of the engineer and all concerned, the sticking of the valve stopped at once.

A somewhat similar incident happened recently, in which the strains caused by an unsupported pipe made trouble, not to the safety valve, but to the flange, riveted to the boiler, to which the steam pipe was bolted. The strains of the unsupported pipe caused a leakage between the boiler neck and the shell to which it was attached. Many times expansion of the pipe causes strains and resulting leakage, but in this instance the leakage was caused solely by the unsupported weight of the pipe and ceased when the pipe was properly attached to a support.

Cleveland, Ohio. Charles Allen.

ADJUSTING STEAM GAUGES.

It does not look well for an establishment to have several steam gauges in the engine or boiler room each of which indicates differently. To be sure the manner in which the gauge is connected has much to do with the indication; for a pair of gauges may be so connected that one may read ten pounds more than the other and yet both give correct indications. This may be due to the pressure of the column of water in the pipe above the level of one gauge. For instance: two gauges are connected to the same boiler, one being placed above the boiler with only a gooseneck and a valve intervening between the instrument and the steam generator, the other being placed 100 ft. away from the boiler, in a cellar, and the pipe connecting the gauge and the boiler descends to the instrument in the cellar.

UNION FOR RECORDING STEAM GAUGE.

The vertical distance between the horizontal pipe and the gauge is 22 ft. The gauge in the cellar always indicates about 10 lb. more pressure than the gauge at the boiler, and this excess of pressure is due entirely to the weight of the column of water in the pipe, above the level of the gauge. That this is the cause of the extra pressure is easily proven by bleeding the vertical pipe until all the water has run out, leaving nothing but steam in the pipe. Then it will be found that both gauges indicate alike, provided of course that they are both correct.

Steam gauges are easily kept in condition if the engineer will only compare each one, periodically with a master gauge, which in turn should occasionally be sent away for comparison with a mercury column. All good makes of steam gauges contain means for adjustment so they may be made to work in unison with a master gauge. Recording gauges also are made with means of adjustment. Gauges of this class often become deranged through freezing, or by the admission of live steam to the spring of the gauge. The latter is the most common cause of a spring going "light," i. e., indicating more than the boiler pressure.

A recording steam gauge should always be attached to the steam piping by means of a union immediately below the gauge. The upper part of the union should be drilled about 1/32 in. for the admission of pressure, while the lower portion of the union should have a hole possibly smaller in diameter. When capillary connections are thus arranged it is seldom that the gauge spring is affected either by steam or by freezing, as little water or live steam can find its way through the small hole and the small quantity of air confined in the pipe above the union, is forced into the gauge and made the medium of pressure transmission in the spring of the gauge.

When a recording gauge fails to register with the steam gauge, proceed to compare both gauges, taking readings every five pounds, with an increasing pressure, then take similar readings with a falling pressure. It is sometimes found that there is more variation in the increasing pressure readings, than in the readings when the pressure is falling. When such is found to be the case it may be due to the lost motion in the gearing of one or both of the gauges.

To adjust the recording gauge, move the pointer, either by shifting the rivet or by bending the pointer, until the latter is

brought to zero at atmospheric pressure. Then attach the gauge to some controllable source of pressure, and compare the readings of the two gauges, i. e., the recording gauge and the steam gauge on the boiler or a master gauge.

All that is necesasry to obtain the desired controllable pressure is to connect the two gauges to the same steam pipe, and to place a valve between the gauges and the boiler. Then steam can be admitted to the gauge pipe in any quantity, and the pressure may be run up by a proper manipulation of the steam valve to each five-pound mark, and held there as long as is necessary for the proper comparison of the two gauges.

The comparison may be readily made with a falling pressure by merely closing the steam valve leading to the boiler, and then "bleeding" the gauges. If there is no valve in the pipe unscrew one of the gauges a little and the leakage thus caused will quickly reduce the pressure to the desired point.

Ordinary steam gauges are adjusted so as to register with the master gauge at various pressures, by increasing or decreasing the leverage of either the geared segment or one of its connections, means usually being provided for that purpose in the construction of the gauge. All gauges that are not provided with means for such adjustment are of so cheap a variety that they should not be purchased, but should be rejected in favor of a better type of gauge.

BOISE, IDAHO. JAMES F. HOBART.

WIRING FOR VOLTMETER CONNECTIONS.

Examination of several plants in this vicinity shows that there are at least two ways of connecting voltmeters, and I wish to inquire which is the best. Fig. 1 illustrates the back of a switchboard, showing horizontal bus-bars and vertical wires. Connections are made to the upper and lower bus-bars in the ordinary way, after which these wires are carried through the switchboard just below 2 and are then attached to the main switch. They are then taken from the upper part of this switch and brought back through the switchboard again near 2. At this point two small wires connect with the voltmeter at 3, while the main wires are continued downward at 4 and 5. From this description it will be plain that when the main switch is pulled out connection with the voltmeter is severed, and as a matter of

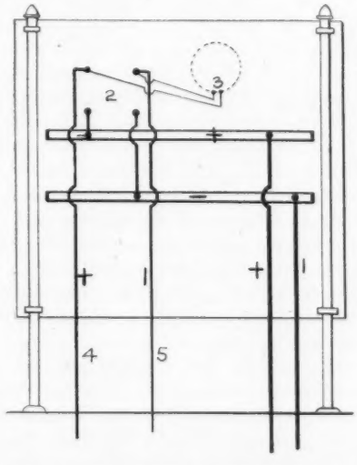


FIG. 1.—REAR VIEW OF SWITCHBOARD.

course when starting up the plant, no voltage will be indicated until after the main switch is thrown in, unless the plan of leaving it in at all times is adopted, which is not always desirable.

Fig. 2 shows the same switchboard except that connections for the voltmeter at 3 are taken directly from the bus-bars; therefore, the meter is always connected to the dynamo, as the position of the main switch has nothing to do with the voltmeter. When the dynamo is started the voltage is shown before the main switch is thrown in, and when it is pulled out at the end of the run the voltage does not change.

Why are these different plans adopted? Does it make any special difference whether one or the other is used? Fig. 1

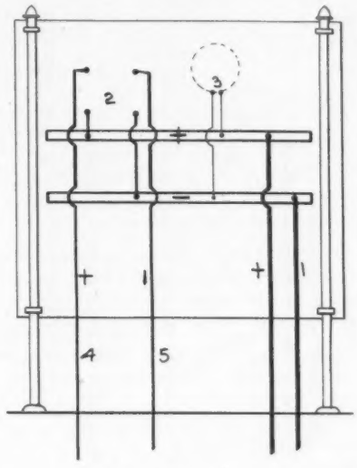


FIG. 2.—CONNECTIONS ON BACK OF SWITCHBOARD.

seems to be the most natural way. What are the objections to it? I shall be pleased to read the opinions of others on this subject.

PITTSBURG, PA. JOSEPH THOMAS.

INVENTIONS WANTED.

Next to being an inventor, one can assist invention by stating inventional problems. If readers having ideas were to do this in your letter department the electric art would stride along even faster than in the past. Invention has been the main cause of its growth, and the basis of the wealth and living of hundreds of electrical men. Therefore, invention will continue to be a field for prosperity for the inventor, for the reason that the more inventions there are, the more there will be, as each inventor is always the parent of, and necessitates, others. From time to time, since reading one of your editorials suggesting such a course, I have made notes of some of the present practical problems, which I give below:

The automobile shock absorber is still below par and the passengers still act as the absorbers, to a great extent.

How about some means which will keep a multi-rate meter wound up, when it is dependent upon clock work?

Party lines were formerly limited to two, and now to four subscribers, I think. Who will show how to increase the number?

Fire hose lies folded, and hence disintegrates with damp weather. Inventors are trying to keep the folds apart, and yet be able to put the hose into use quickly in case of fire. But the hose still lies flat.

There is yet a chance to overcome existing difficulties and objections in self-exciting alternators.

Street car conductors have to waste valuable time in trying to find the wire for the trolley. They look like blind men when undertaking to perform this feat and afford much amusement to bystanders.

It is evident that even the Western Union would change from the slow telegraph key to a quick method, when the rapid device is equally reliable.

At last the reciprocating piston steam engine has been converted into a rotary engine or turbine, and other reciprocating devices have become rotary. Can any one make a rotary sewing machine without reciprocating parts? The speed of sewing could be increased in about the same proportion as the steam engine shaft was increased in speed. Those subject to dizziness had better leave this problem alone. Magnetism may assist, possibly.

The watchman's clock still permits the watchman *not* to make his periodic inspections. It needs a system which will make it impossible for the watchman to cheat the installment.

Where is the small electric heater for cooking that will not give out, and cost half the first cost to repair it? I just had one fail while in proper use boiling water. The electrician who delivered it said it "might go back on me," if something were not boiling. Must a cook always keep "something" on the stove? What cook could be depended upon for this. There was a fuse in my case.

When the trolley pole leaves the wire it should fall below the level of the wire to prevent damage. It needs more brains than heretofore given to insure good results from severe tests. The principle should be right. It needs competent analysis and study, and then combinations that *must* work, *always.*

Think of the enormous increase of business from automatic penny slot machines, if accompanied by a simple automatic machine that would make change for dimes and nickels at least. I have noticed many a person feel for the penny in his pocket, but not finding it, and having only larger coins, depart.

The telephone repeater is still a practical failure.

Our university professors have the field open for wireless syntony. They are the best posted for such inventions.

The automatic synchronizer for alternators is still a favorite subject for invention among the more prominent engineers.

It is proposed to locate ores and subterraneous water electrically, but who can show how to do it?

Difficulty exists in causing magnetic ore particles and foreign dirt to fall apart completely in magnetic ore separators.

Damage has happened in starting compressed-air motors under load.

When engineers have troubles with outlet boxes they should put on their thinking caps and provide such improvements that those troubles will not happen again.

A comparatively new field for invention is the lifting magnet, and hence a chance for fair profits.

Must we continue to ride in automobiles, and, instead of inhaling the fresh air of the country, breathe foul products of combustion of gasoline? While passing through the street, we don't like to share the products from other automobiles, either.

When one calls upon another, at an office or a home, it is usual to find either an office boy or maid to take the name or card. How much more necessary that the telephone should register, at a subscriber's office, similar information, so that on return the subscriber may call up the caller.

Will not others send you problems?

New York. J. L. Thatcher.

MOTOR INSTALLATION IN BOILER AND MACHINE SHOP.

When it is found that a business is not paying one of two things must be done: either go out of business, or reduce expenses or cost of production so that it will pay. At the time of which I write we were running a small boiler and machine shop in which we did general repairs and new work along these lines. For a number of years the business had paid well, so that from practically nothing we had accumulated quite a stock of machinery, tools and material, and some capital. But at last there came a continued slump of work; business fell very slack, especially in our line, and we awoke to a realization of the fact that we were going backwards at an alarming rate. So we had to face the problem, and decided that our running expenses could be very much reduced. And here is where the electrical interest enters.

Our shop equipment was as follows: One combined punch and shears, old style; radial drill press, upright drill press, large flanging forge and blacksmith forge, both taking air from same fan; set bending rolls, 28-in. engine lathe, 22-in. engine lathe, 24-in. by 24-in. by 5-ft. planer, power hack saw, two-wheel emery grinder.

All of above, except the rolls, were driven by a 20-hp upright boiler and a 15-hp upright engine, both of which must have been built "before the war." The rolls were driven by a 8-hp reversible engine, which took steam from the shop boiler. The boiler was situated at one end of the shop, the engines at the other, with the pipe lines uncovered: I mention these facts as they have some bearing on the proposed electrical installation by giving an idea of the degree of efficiency at which the plant was running. Our building was two stories, with the machine shop upstairs, while the boiler and blacksmith shops were on the ground floor. This necessitated a good bit of shafting, causing another cut in the efficiency. We figured our weekly expenses as follows:

Coal, two tons	$6.70
Fireman's wages	12.00
Water, oil, etc.	.46
Repairs	1.10
Total	$20.26

That was the way the facts looked, and we were all studying the best manner of reducing the list, when one of the partners suggested electric drive. That sounded pretty good to all of us, but what kind of electric drive was the next problem. There were three ways open to us, namely: (1) Driving all with one motor, (2) driving the boiler and machine shops with separate motors, (3) individual motor drive on each machine. As none of us knew a great deal electrically, we could not settle the question. The general advantages were apparent to us all; no waiting for steam to get up in the morning if the firemen were late, or in case of a night hurry job, as we often had; no running the whole shop for one machine; no belts breaking at the wrong moment, and we could think of a thousand and one reasons why we should have electric drive. The only drawback was the cost of installation and whether there really would be a saving in the expenses. The only way we could find that out was to call up an electrical firm and get it to send one of its experts to go over the plant and give us estimates.

As usual the expert arrived on our particularly busy day, but we showed him over the plant, which was then running at full blast. He investigated everything pretty thoroughly, accumulated considerable data, and then left us with the assurance that we should hear from him. And we did. Below we give the list of the motors he said we should need: 2-hp shunt-wound motor, radial drill; 2-hp shunt-wound motor, drill press; 10-hp compound reversing motor, rolls; 7½-hp compound-wound motor, punch and shears; 2-hp shunt-wound motor, blower; 3-hp shunt-wound motor, lathe; 3-hp shunt-wound motor, lathe; 5-hp compound-wound motor, planer; 1-hp shunt-wound motor, grinder and hack saw.

Moreover, he reported that our plant, the load being so very intermittent, would be ideal for electric. Also that the above outfit, together with some necessary alterations in arrangements of machinery, would cost installed complete $1,100. He named a very low rate for the energy and hoped to receive our order.

But before we could do any ordering we felt we must do some investigating. We could not understand that what we had been driving with a 15-hp engine in the very worst condition should need 25½ hp of electric drive, and brand new at that. We decided to get other estimates and so let a certain motor concern give us a figure on the plant. They reported that a 7½-hp motor upstairs and a 10-hp motor downstairs would do the driving. Again, we could not understand why there should be such a difference in the reports of the experts.

However, we calculated from the rate given us that our running expenses with first-proposed electric drive would cost us $18.06 (I am not at liberty to give the rate quoted). This would mean an average weekly saving to us of $2.20; as the cost of installation was to be $1,100, it would take us about 10 years to save the cost of the plant addition.

We finally decided that the expert's figures were too high, so we are commencing to install the motors one by one, cutting out a machine at a time from the steam drive. In this way we hope to have the whole plant running by electricity in time, and we are pretty certain that we shall in this way effect a saving of about $5 per week on our running expenses.

Cincinnati, Ohio. Thomas K. Bowne.

QUESTIONS AND ANSWERS.

In assembling the laminated core of a transformer what is the best means of insulating the sheets from each other to prevent the circulation of eddy currents? I wish to be able to take the core apart if desired. (2) In what way does the "singing" arc differ from any other type beyond requiring the use of homogeneous carbons? C. E. F. F.

Japan one side of each sheet or both sides of every other sheet. (2) The lamp should preferably contain very little mechanism and be fitted with soft carbons if the best results are to be obtained. Any commercial arc lamp fitted with soft carbons will give fair results. It is assumed, of course, that the proper superposed currents are available.

What type of lightning arrester is best for a three-phase 11,000 volt transmission line? (2) How is the enamel, the formula for which was given in the July 7 number, prepared for use? (3) Are reinforced concrete poles suitable for use on 11,000-volt transmission lines? Would wooden or angle-iron cross-arms be best? E. W. B.

Any of the manufacturers of lightning arresters can furnish an arrester suitable for this tension. (2) The ingredients are well mixed and then fused, after which the molten mass is allowed to flow over the resistance wire which should be hot. The cooling should be gradual. (3) There is no reason why such poles could not be used, if they are not now used. The cross-arms should be of iron so as to make the construction throughout very strong. Wooden cross-arms, however, are also used.

The writer contemplates installing a telephone cable on a pole line at present carrying a 16,000-volt, three-phase, 60-cycle, alternating-power circuit, providing the inductive effects will not be objectionable. The present amount of power transmitted is approximately 200 kw. This will be increased to perhaps 1,500 kw within the next year. The distance between the power line and the telephone cable will be from 15 to 20 feet, averaging 17 feet. Our telephone system is an automatic central energy one having one side of the line grounded through a relay, the other line grounded through a similar instrument but having a 35-volt storage battery in series with it. My intention is, of course, to ground the telephone, cable and messenger wire. The length of the line will approximate three miles. Will you kindly inform me through your columns if I can count on satisfactory service with the telephone arranged in this manner? W. A. R.

There is no reason why a system installed as outlined should not operate satisfactorily.

Kindly advise us what is the specific resistance at atmospheric temperature and the composition of carbons usually used for arc lamps; also the carrying capacity of the carbon at atmospheric temperature?
E. C. S. Co.

Carbons for arc lamps are made of lampblack, gas retort carbon, petroleum coke, tar, waterglass, molasses, etc.; the best carbons being made of lampblack and tar, the latter serving as a flux. Cheaper forms are made of gas retort carbon, petroleum coke, etc., with different binders, depending on the manufacturer. The specific resistance will, of course, vary with the composition. Foster gives the specific resistance in microhms per cubic centimeter of arc light carbon as about 4,000 at zero Centigrade; it is also variously given as 0.0075 ohm-centimeter, while the resistance of ordinary arc lamp carbons, 11 to 15 millimeters in diameter, is stated to be from .15 to .2 ohm per foot. The carrying capacity, if it is intended to use the carbon as resistance, should be kept below that used in arc lamp operation.

Please advise me of the latest invention on series alternating current incandescent street lighting systems. What I particularly want covered is the problem of a continuous light in the face of any one or several of the lamps in the circuit burning out? P. L. & P. Co.

There are two main systems of series incandescent lighting in use at the present time. In one the lamps are operated in series in a loop across high-voltage constant-potential mains; in the other the lamps are operated in series from a constant-current transformer or regulator. In the former system, a shunt coil is connected across each lamp to provide a safe path around the lamp in case a filament is broken or is burned out. When this happens all the current is forced through the shunt coil which is wound on a laminated iron core magnetized almost to saturation, and owing to this high saturation, the counter e.m.f. of the coil rises but little above the voltage of the lamp which it displaces. Thus the operation of the other lamps in the circuit is not affected. In the latter system a film cut-out is located in the base of each lamp and closes the circuit if any lamp fails. The essential part of this cut-out is a thin insulating film which normally separates the two lamp terminals. If a filament breaks the voltage across the lamp terminals rises a certain amount until it punctures the film and short-circuits the lamp. There is no lost energy with this latter system but it is a trifle more expensive and somewhat less flexible than the former.

I would like to ask the following questions on the stator connections and windings of induction motors having "squirrel cage" rotors. How is the stator winding changed so that the motor can be run on either 220 or 440 volts? Is it not a fact that most commercial induction motors have two distinct windings for each phase and are connected in parallel for 220-volts and in series for 440-volts much the same as in transformers? How is the stator of a 5-hp, 60-cycle, 220-volt, three-phase induction motor connected up to give a "squirrel cage" rotor winding a speed of 1450 r.p.m. at full load? Four pole or two pair of poles give a speed of 1,800 r.p.m.; 3 pair, 1,200 r.p.m.; 4 pair, 900 r.p.m., etc. The firm I am with recently received four 5-hp, 60-cycle, three-phase induction motors intended for operation on 220-volt circuits with "squirrel cage" rotors; one or two are marked 1,130 r.p.m. and the others are marked 1,450 r.p.m. The synchronous speed would evidently be about 1,500 r.p.m. I could not figure this speed by means of the formula for obtaining speeds for 60 cyle, three-phase motors? Is there any good book containing detailed information on the windings of induction motors? J. B. C.

It is the practice of one of the leading electrical manufacturing companies to use the same induction motor for 220 volts and 440 volts. The primary winding in each case is ranged in groups, according to the number of phases and poles, there being one group per pole per phase. One-half of the coils for each phase is connected permanently in series. The two halves are then connected in series for 440 volts and in parallel for 220 volts, no change being made in the secondary winding. It is not possible to wind a 60-cycle induction motor for a synchronous speed of 1,500 r.p.m. A 25-cycle motor, however, can be wound for this speed. It may be stated that the rotor windings of commercial induction motors are frequently made the same for 60 and 25-cycle machines. It may be possible that the rotor which is marked 1,450 r.p.m. was initially intended for a 25-cycle machine. It is equally possible that the marking is incorrect, and that it should have been 1,750. There are a number of good books on the windings of induction motors; among these are "Die Wicklungen der Wechselstrommaschinen," by E. Arnold; "Armature Windings," by Parshall and Hobart; "Polyphase Electrical Machinery," by S. P. Thompson; "Wechselstromwicklungen," by R. Krause, and "Alternating-Current Windings," by C. Kinzbrunner. It may be interesting to know that with the exception of very large machines which require special windings, the primary cores of an excellent line of induction motors are equipped with form-wound coils, which are placed uniformly in slots around the inner circumference. Each coil covers an arc slightly less than the total circumference divided by the number of poles for which the machine is designed. After the coils have been placed in the slots (the top half of one coil being placed in the same slot as the bottom half of another coil) the terminals of the coils are arranged in groups according to the number of phases and poles for which the machine is designed. The coils of each group are connected permanently in series, thus leaving two terminals per group. Alternate groups for each phase are then connected in series, thus forming four terminals per phase. These four terminals are connected so as to place all of the coils in series if the machine is to be wound for a high voltage, or they are connected in parallel so as to give a voltage of one-half of this value when desired. The individual coils are similar in almost every respect to the coils used in an ordinary direct-current armature, the difference being that their mechanical shape is such that they may be placed in the inner circumference of the core, while the direct-current armature coils are placed on the outer circumference.

CENTRAL STATION SALE OF CURRENT

Warrantable Expense for Meter Testing.

An interesting paper was read by Mr. O. J. Bushnell, superintendent meter testing department of the Chicago Edison Company, at the annual convention of the Northwestern Electrical Association on "Warrantable Expense for Meter Testing." The author said that probably the most important point to be considered in connection with this subject is the frequency with which meters should be tested. Most central station managers believe that, as a matter of general policy, meters should not run much longer than a year without testing. We cannot, however, arrive at the proper frequency of tests with any correctness without a study of the conditions which affect meter accuracy. These are: roughening of jeweled bearings; changing of the permanent drag magnets; wearing of the commutator and brushes, and dampness and dust. For sapphire jewels a limit of one million revolutions of the meter shaft has been generally adopted as the limit of wear in all commutator meters. In induction meters the writer believes the limit of wear of two million revolutions adopted by a large Eastern company is certainly safe. About two and one-half years ago there was discovered a process of cupping diamond jewels for meters and since then they have come into considerable use. It is believed that the life of these jewels can safely be taken at five times that of sapphire jewels and that probably it is more than this. It is evident that meters of large capacity should be kept in better condition and more frequently tested than those of small capacity. Mr. Bushnell favored the adoption of a classification for different meters by which they should be tested. This classification adopted by him about two years ago for commutator meters was as follows:

Annual tests for meters of 5 to 10 amp. capacity.

Semi-annual tests for meters of 15 to 50 amp. capacity.

Quarterly tests for meters of 75 amp. capacity and above.

Meters making over one million revolutions of the disc between tests on the foregoing classification to be changed to a more frequent class so as not to exceed that number between tests, up to the quarterly class.

Where a meter has not retained its calibration as long as three months an investigation has been made. Such rapid loss of accuracy is usually due to commutator trouble caused either by excessive vibration or heavy momentary overloads. Cure for the first trouble is mounting the meter on a spring board and for the latter trouble the installation of a larger meter. Interesting data were obtained from tests made according to the foregoing schedule. The quarterly tests at one-half load show 15 per cent more of the meters to be accurate than the annual tests, and 10 per cent more than the semi-annual tests, while the improvement shown by the light load tests which are made at 1/10 load is still more marked. The same increasing ratio of improvement with more frequent testing is seen in the average accuracy obtained from the tests, which was as follows:

	½ Load.	1/10 Load.
Annual tests	97.3 per cent.	98.6 per cent.
Semi-annual tests	97.8 "	90.8 "
Quarterly tests	99.1 "	96.5 "

At one-half load the ratio of meters slow to those fast was 2 to 1, while at 1/10 load it was 5 to 1. Type "C" commutator meters with light moving elements maintained their accuracy much better than older meters with heavier revolving elements. Induction meters, owing to the light weight of the moving element and absence of commutator friction, retain their accuracy better than the commutator type. Induction meters have been classified by the writer for an annual test. Data compiled from about 14,000 annual tests showed an accuracy almost identical with that of commutator meters under quarterly testing. Induction meters measuring the largest consumption will, however, during the coming year, be tested more frequently, and those which show over three million revolutions between tests will be put on semi-annual test.

The next question is as to the advisability of making installation tests. Meters transported some distance are liable to slight changes in calibration. Two of the largest companies in the country make a test on every meter installed before the first bill is rendered, notwithstanding the fact that the meters have previously been corrected in the testing room. In the Chicago Edison Company it has been the practice to have all meters after installation inspected, cleaned and adjusted to run freely on a light load. To determine whether such an inspection or test is advisable, the writer made 100 tests of commutator meters and 100 tests of induction meters immediately after they were installed, these meters having all been adjusted in the shop before being sent out. The accuracy after installation as shown by these tests was rather disappointing, especially in commutator meters on light loads. Meters tested after installation showed a decidedly improved condition. It is particularly desirable that the bills of a new customer should be absolutely correct, because if a meter is slow for two or three months and is then corrected, it leads to the suspicion that the company is increasing the bills arbitrarily after it feels sure that the customer will be permanent. The conclusion seems warrantable that both alternating-current and direct-current meters involving considerable consumption ought to be tested within one month after installation. The direct-current meters will be left in a more permanent condition if allowed to run for two weeks before testing, so that the commutator will have become oxidized. The necessity for installation tests previously shown proves conclusively that meters should be tested under local conditions in which they are to operate, and after all danger of change from transportation is over. Four methods of testing are in general use.

1. With ammeter, voltmeter and stop watch. 2. With calibrated resistance, voltmeter and stop watch. 3. With indicating wattmeter and stop watch. 4. With check recording wattmeter.

The check recording wattmeter has the advantage of not requiring a stop watch, yet if a portable load is used the inspector can tell the per cent load on the meter with sufficient accuracy. An ordinary meter can be placed in a carrying box and used for checking, but it is better to use one of the special test meters of which there are two or three kinds on the market. These meters are built with several field windings so that the full torque of the meter is available at different loads. Each method of testing has its advantages. The writer has had all in use and finds no particular advantage of one over the other in the amount of work which can be accomplished. He inclined to the belief, however, that the test meter with several field windings will soon have more general adoption and prove slightly more economical than other methods. The number of meters which can be tested by an inspector in one day has been variously reported by different companies from which data was secured at from 6 to 10. The writer believes an average of about 7 should be obtained in testing commutator meters and 8 or more in testing induction meters.

We come now to the question which many may consider the most vital to the subject. What will a thorough system of meter testing cost? The money actually spent on this work in different companies from which figures were received by the writer varied from 48 cents to $1.63 annually per meter installed. In the writer's experience a thorough system of testing based on the principles outlined in the paper could not be carried on for less than about 75 cents per meter installed for induction meters and $1.50 per meter installed for commutator type meters annually. These figures include the cost of all instruments,

apparatus and supplies necessary for carrying on work as well as the cost of material used in the meters and labor. The salaries of meter testers is assumed to be from $50 to $65 per month for the most part and helpers for testing large meters at $40 per month. The amounts given will not be spent on every meter. A third of it would cover the cost for a large part of the meters, but two or three times this amount would be necessary for other meters which are tested quarterly. Of course for meters measuring little consumption the limit of expense is reached when reasonable accuracy is obtained, but for meters measuring a large consumption the cost of meter maintenance may be inconsiderable as compared with the loss of a fraction of one per cent in registration.

DISCUSSION.

Mr. F. W. Insull said that keeping meters in good shape to register accurately paid not only on account of the company's income, but because it put the company in a good position with the public to be able to say that a meter had been tested at some recent date. As to the loss of income from meters running slow, he said his company has in the past five years taken over many miscellaneous small companies which had meters of all kinds which had been given but little attention. In some of these old plants the amount of energy formerly paid for by customers had been only half what it was after the meters were overhauled.

Mr. Bushnell, in answer to a question as to what was done with old obsolete meters which were taken off the lines of the Chicago companies, said that these were sold to those making a business of second-hand meters for about $1 apiece. The second-hand meter man fixed them up so that they would register with tolerable accuracy on full load. They were then passed on to the smaller central stations. He did not recommend to any central station company the purchase of second-hand meters.

President Almert said that he had found in taking over small companies that there was much revenue being lost because of old meters which ran very slow on light loads. He called special attention to the necessity of having the checking instruments used in testing meters accurately calibrated. He knew of one case where the indicating wattmeter used in this work was 5 per cent low, which resulted in all the meters on the system being calibrated low. When it is considered how many small plants have a lot of old meters which register almost nothing on light loads under which they ordinarily work, it is a wonder that such companies can make ends meet at all. In one company he was familiar with, out of 160 customers 40 were on flat rates and 67½ per cent of the total kw-hour output went to the flat rate customers and to lost and unaccounted for energy. In that particular company he thought the condition of affairs could easily be reversed.

Outline Lighting.

Mr. Homer Honeywell, of Lincoln, Neb., presented a paper at the recent meeting of the Northwestern Electrical Association on "Outline Lighting," which is printed below, together with the discussion which followed its reading:

The Lincoln Gas & Electric Light Company organized a New Business Department with a competent manager at its head, about the first of February, 1904, and started out with well defined ideas as to the desirable classes of business and the effects on the station load. It was the aim to take on a steady load that would run from dusk until midnight each and every night during the year and to that end a flat rate was figured out based on the Doherty rate of $1.80 per year for each connected 16-cp lamp, or its equivalent; $12 per year for a customer charge and 6 cents per kw-hour for energy used, all subject to a discount of 10 per cent for prompt payment, and on the actual number of burning hours as applied to Lincoln.

No flat rates are taken on inside lighting. We have free renewals and do it whenever our men see a defective lamp in use.

The outlining is installed free when two-year contracts are taken and the cost of installation figures about 38 cents per 4-cp lamp installed, the lamps being placed 18 inches apart. By this method a number of small stores were induced to light up. The small merchant with a strip of seventeen 4-cp lamps over his sign, burning each and every night from dusk until midnight, turned on and off by us, pays $5.30 net per month. At the present time there are in use the equivalent of 10,000 4-cp lamps for sign, outlining and window lighting, and used by barbers, shoemakers, livery stables, undertakers, second-hand stores, bootblack stands, butcher shops, lunch cars and popcorn stands; in fact, all kinds of business. No business is too peculiar or small to be a "prospect." We have one customer, a clothing store, whose sign, outlining and window lighting, amounts to 960 4-cp lamps. This was the first customer to get into the game and we have used him as a pacemaker.

It is claimed that the display lighting is one of the most valuable assets of Lincoln and it certainly has a far reaching effect. People promenade the streets and can inspect the goods displayed at their leisure. All of the large-sized show windows have light-colored stucco ceilings and are lighted by trough reflectors. Artistic, well-dressed, frequently changed windows are the rule in Lincoln. Progressive merchants aided by the Doherty rate are responsible for the handsome appearance of the streets at night. Had we attempted to install display or advertising lighting on a flat meter rate, even though the rate was lower than the present rate, it is more than doubtful if we could have gotten the merchants interested. An appeal to the merchant's civic pride and a showing of the very small cost for a big lot of good advertising works wonders. Six o'clock closing is the rule in Lincoln every night except Saturday, and it would seem that the smaller towns, where the stores keep open every night or two nights a week, and the people have few places to go, would offer a fine field for display lighting. Well-lighted windows and outlining displays, will bring the people on the streets at night, cause the merchant to put better goods in his window and display them to better advantage.

In soliciting we are always careful to impress on the prospect's mind that the outside and window display is an advertising and not a lighting expense.

Solicitors are paid a small salary and a percentage of the increase in gross revenue, over the same month for the previous year. Each solicitor's commission depends on the number of points he has in proportion to the total number turned in and points are given for each dollar of estimated revenue, as follows: Industrial business, 10 points; additional inside consumption, 10 points, new contracts, 5 points; outlining or signs until 12 o'clock, 10 points; outlining or signs less than 12 o'clock, 5 points; outlining or signs on meter, 3 points.

If the business is taken from the competition the points are doubled. Each man is responsible for his own territory and is keen to hold business, as well as to get new business.

Personal solicitation, newspapers, mail advertising and personal letters are used and the cost of getting business to the company for the past three years has been 43 cents for each one dollar of increased revenue procured. The costs are divided as follows:

Advertising	.05
Construction	15.05
Solicitation	22.05

Of the advertising done at the start I believe the mail advertising was the most valuable. It was done on a fairly large scale and in a way that was new to a great many people. The first week one letter or card was sent out, the next week two and so on until the prospect received a letter or card every day. The mail advertising helped put the prospect in a receptive mood and the solicitor was able to close quickly. The combination of mail advertising and personal solicitation is a strong combination.

The effect on the station has been gratifying. The increase

in peak load has been 23 per cent, while the sales have increased 60 per cent.

The sales of signs was not pushed particularly until we had made considerable headway in the other forms of lighting. At the present time we have 48 lamp-lettered signs in use, all of them bought outright from the local sign builder. The reason for installing free outlining on two-year contracts, and not installing free signs is apparent. The outlining can be taken down, be repainted and put up again anywhere at a very small cost, while a sign to be used again would have to be remodeled at a considerable expense. Then, too, the first investment for a sign is considerable, and if the merchant is not required to carry the investment he feels more free to discontinue the use of the light. During the past three years we have not had over five or six outlining contracts discontinued, where the merchant remained in business, but on the other hand most customers have increased their display.

There are in use 8,500 4-cp lamps for sign, outlining and sidewalk showcases. All these are on a flat rate. For window lighting, 900 16-cp lamps are used. Outlined roof signs also seem to be a popular and cheap method of advertising. So far all the outlining has been done along straight lines, but we are now attempting to relieve the plainness by getting into curves and circles.

Our sales for the past year have been 689 kw-hours for each kilowatt connected. The Sunday output runs about 63 per cent of the average weekly output, and is largely due to flat rate lighting.

There is a municipal street lighting plant here and the traction company supplies some commercial light and power; but the generous display lighting is not due to competition, as our so-called competitor has but three outlining customers and two customers using signs of respectable proportions.

DISCUSSION.

The discussion on Mr. Honeywell's paper served in general to call attention to the tendency to adopt flat rate contracts for sign lighting and have the company turn the signs on and off, rather than depend on time switches or on the customer, who may try to economize by having his sign off much of the time when it would be on under a flat rate contract. Mr. Almert said he had not had very good experience with time switches so far, but he stated his expectation that a better switch would be available soon.

Mr. John S. Allen, of Lake Geneva, arranged with each customer to turn his own sign on at dusk and this privilege was rarely abused. He then contracted with the night policeman of the town to turn off the signs. In this way the turning on and off was done in a small town without the expense of a patrolman. He called special attention to the figures given in Mr. Honeywell's paper as to the increase in load at Lincoln, where the sales have increased 60 per cent and the peak load on the station only 23 per cent as a result of taking on this class of business.

Mr. W. B. Johnson, of Madison, thought that as a rule signs were easier to introduce than outline lighting because they were more distinctively an advertisement for a certain merchant. As to the effect of show window lighting, it was a good plan for the solicitor to have the merchant watch his show window from the back of the store when the interior of the store was dark, noting the number of persons who had stopped to look at the show window when lighted and the number who stopped when the window was not lighted. A demonstration of this kind is very convincing. At Madison they have the equivalent of 8,000 4-cp lamps on flat rate contracts in sign, outline and show window lighting.

Mr. Lord, of Waupaca, said that the early closing of stores which was now quite general had affected central station revenues seriously in the past few years. Display lighting of this kind would get back some of the revenue lost through the shutting off of the lamps in the interior of a store. In small towns flat rate sign contracts would have to provide for turning off current much earlier than in cities.

A Central Station Exhibit.

The Oklahoma Gas & Electric Company of Oklahoma City, at an electrical convention held in that city Nov. 26 to Dec. 8 last year, made an interesting exhibit of its various methods for supplying the wants of the public with gas and electricity. In Figs. 1 and 2 herewith are illustrated the electrical portion of the show. At this exhibition demonstrators were engaged by the company to show up the various devices. These consisted of flatirons, a full equipment of electric kitchen utensils, luminous radiators, electric pumping outfits, sewing machine motors, three-phase and single-phase large power motors, and all the latest appliances known to the electrical world in general. Among other exhibits of this character were soldering irons, electric drills and grinding machines. This exhibit attracted a great deal of attention and as an educational factor is considered by the company to have done much good.

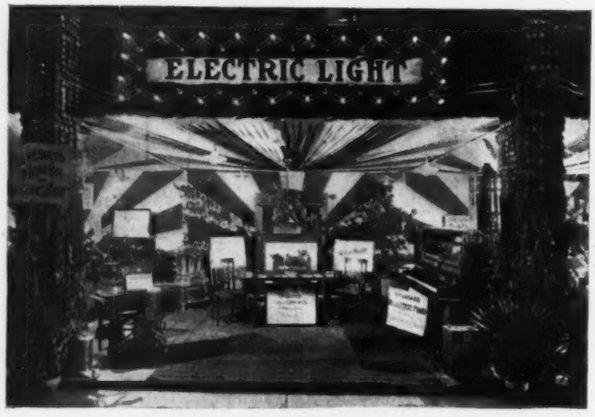


FIG. 1.—ELECTRIC LIGHT EXHIBIT.

There was also a gas department of the exhibit, in which were included the most modern types of gas appliances and ranges. These were operated by ladies of the various churches who are customers of the company and who are using the gas ranges in their homes.

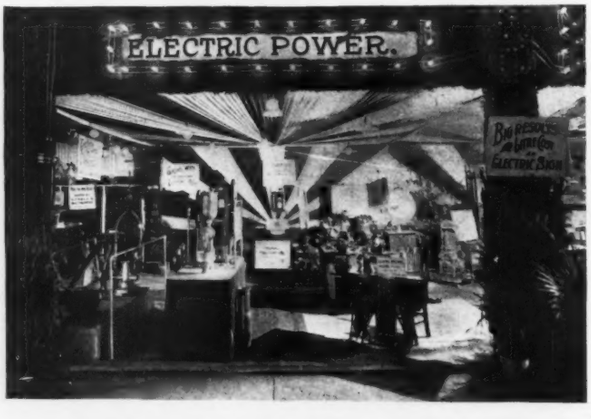


FIG. 2.—ELECTRIC POWER EXHIBIT.

Another portion of the exhibit consisted of gas and electric meters in operation, with an attendant to explain to the spectators how the customer could read his own meter, and thus determine for himself the amount of gas or electricity he was using. As there is great uncertainty in the minds of the public as to those classes of meters and the method by which they are read, this part of the exhibition attracted considerable attention, and it is believed did a great good in convincing the public as to the care and conscientiousness with which the meters are read.

Premiums to Employes.

Mr. Ernest Gonzenbach, general manager of the Sheboygan Light, Power & Railway Company, gave an interesting talk at the recent convention of the Northwestern Electrical Association, on the premium systems employed by his company. He pointed out that in manufacturing enterprises the plan of giving premiums to employes for an extra amount of work over certain standards was well known and in common use. The premium system or point system of paying solicitors at Lincoln, Neb., is referred to elsewhere in a paper presented at the same convention by Mr. Homer Honeywell. A similar system of paying solicitors according to the amount and character of business obtained was in use by most of the companies controlled by Mr. Henry L. Doherty. The premium system is used at Sheboygan with the power house employes and with the company's new business board, a description of which is given below.

At the time this system was begun the company's cost for coal, oil and repairs was about 1.1 cent per kw-hour. It was arranged that 10 per cent of all saving below this figure should be given as a premium to the power house employes. This premium is charged to power station labor on the company's books. From $40 to $80 per month is now paid out in premiums as a result of the saving caused by the premium system, due to the greater interest taken by all power-station employes in economical production. The premium is divided among employes according to rank. The engineers, of course, get the highest percentage, the oilers receiving the lowest. It has resulted in producing a spirit of co-operation to produce the best operating economy, as every man is trying to do his best and to help every other man to do his best. Firemen object if engineers run engine units very much underloaded when it would be possible to shut down one unit, and engineers watch the firemen's performances in the coal room. Every employe is on the lookout to prevent hot bearings and avoid expensive repairs which might wipe out the premium. A careless employe cannot remain long in such a station as his fellow employes will not tolerate carelessness which is likely to wipe out the premium. This has been practically demonstrated. Mr. Gonzenbach said that perhaps the best recommendation he had for the system was that the company supplying coal complained that the power house employes were unreasonably particular about the quality of coal they delivered. The wages of firemen are $45 per month, which with the premium added, is increased to from $50 to $55 per month.

Mr. Gonzenbach then described the very poor results and discouraging experience obtained with some first-class solicitors for light and power business. These solicitors had been very successful in other cities, but, owing to the peculiar characteristics of Sheboygan people, were not able to show good returns at all. He concluded after a couple of trials that he could not get solicitors from outside to handle successfully the Sheboygan situation. He therefore created what was called a new business board, which was described in the ELECTRICAL WORLD of June 2, 1906. This board consists of the railway superintendent, lighting superintendent, the freight and express agent and other leading employes to the total number of ten. It was agreed that this new business board should have divided among its members 10 per cent of the increase in gross earnings for any month as compared to the corresponding month of the previous year. As much as $110 per month had been distributed in premiums among the new business board and he considered the results very gratifying. It was an incentive to everyone to look carefully after all possible new customers and to be courteous to old customers. He was selling electric flatirons at cost, and had 300 in use in a town of about 23,000 inhabitants. Any employe was given a commission of 50 cents for selling a flatiron.

In discussing Mr. Gonzenbach's talk, Mr. R. N. Kimball, of Kenosha, said that there would be difficulty in working Mr. Gonzenbach's plan in a purely lighting station because the cost per kw-hour depends so much upon the output of the plant, and in a lighting station the output is small in summer and the kw-hour cost high. Mr. Cravath pointed out that Mr. Kimball's objection could be overcome by taking as a basis the corresponding month for a year before the premium system was put into force.

Central Station Signs.

Illustrated on this page is a sign that has just been completed for the Cleveland Electric Illuminating Company, of Cleveland, Ohio, and installed on the Cuyahoga Building of that city. This sign is 64 ft. in length and 70 ft. high. It contains no fewer than 1,053 lamps. It is built entirely on the "groove" method and the illustration shows how effectively

ILLUMINATED SIGN.

this type of construction concentrates the light and cuts off lateral diffusion. The letters are all solid white. The border is of white and ruby lamps placed alternately. The torches are white crossed with bands of ruby. The flames are filled with white and ruby lamps, and by employing seven circuit flashes a very realistic indulating movement of the flames is produced. This sign was made by the A. & W. Sign Company and is lamped entirely with A. & W. four-candle power sign lamps, made expressly for the concern by the Brilliant Electric Company.

Payment of Solicitors.

In a communication to one of our English contemporaries a correspondent criticises the practice of paying to central station solicitors a salary and a commission based upon the number of lamps or the horse-power installed. This practice, in his opinion, is disastrous, as it gives the canvasser no inducement to select only profitable consumers. A lamp connected, no matter whether in bedroom or basement, is just so much in his pocket, and the system may leave the undertaking with a legacy of small load factor consumers or even dead services, especially if a certain class of persons easily got and easily lost is attracted by the canvasser's arguments. A rational method of remuneration, he believes, would be a reasonable fixed salary, plus a commission on the annual percentage increased output of the station's ordinary private power and lighting output. "Under these conditions the canvasser would keep in touch with old consumers and secure 'a continuance of past favors,' and would lay himself out only to canvass for good business. He would leave alone the class of consumers who are always grumbling, those which we would rather leave to our friend the enemy to deal with."

Legal Status of Municipal Plants.

The Supreme Court of Indiana has decided that a municipality operating an electric lighting plant is liable for damages incurred through negligence, in the same manner as an ordinary business corporation. The defence that the municipality was not liable for the reason that in operating the lighting plant, giving rise to the claim for damages, it was acting in a public or governmental capacity, was over-ruled.

Letters to the Editors.

Engineering Education.

To the Editors of Electrical World:

Sirs:—I always read with pleasure any article by my friend, Mr. Behrend, and his article on "Engineering Education" in the first issue of the Electrical World of January was no exception. For, although we cannot perhaps agree with all of Mr. Behrend's views and opinions, they are so obviously sincere and so colored by his enthusiastic personality that they are always interesting and instructive. There is one point, however, on which Mr. Behrend and I always cross swords and that is what Mr. Behrend describes as "commercialism" in engineering. Mr. Behrend has dealt with this question quite extensively in his article. Unfortunately, he has dealt with it in rather an excited manner, and such opinions coming from an engineer so well known and of such high standing as Mr. Behrend are liable to do a great deal of harm in this age, when the greatest fault of the rising generation of engineers is their apparent inability to realize that modern commercial or practical engineering must be carried out on business and not on academic lines.

Quoting from Mr. Behrend, "the average student who goes to the university to be taught represents by no means the fair average of the intelligence of the nation. It cannot be denied that a large number of our young men, especially those of keen intelligence, see in the avoiding of a university education a short cut to fortune." This is only too true; the modern technical graduate does not represent the average intelligence of the nation. Usually a man takes a technical course because he has a natural liking for mathematics, science or engineering and not because his intelligence is above the average. Is it to be wondered at, then, that such a student after receiving the narrow academic university technical education which Mr. Behrend so justly criticises enters the practical world lacking in breadth and in practical common sense. Suppose such a student with narrow academic ideas of engineering absorbing Mr. Behrend's views that dollars and cents are not to be considered and that it is the only function of the engineer to turn out machines which do their work as perfectly as possible. He is told "we cannot put too much emphasis upon the necessity of the engineer being a bulwark against the continual onslaught of the commercial man for the sake of cheaper machinery." Can we wonder that business managers despair when they deal with these engineers.

Quoting from Mr. Behrend's article, "Ths work of the engineer should consist in the careful designing and building of apparatus so that it performs its functions safely and with the least possible waste of both material and power." I am not quite sure what this sentence means. If I were attempting a definition of an engineer I would alter the wording somewhat and say an engineer is one who designs and constructs with the minimum of expense machines which perform their functions satisfactorily. As to whether we call such an engineer a "commercial" engineer or a "scientific" engineer is merely a question of definition. Mr. Behrend strongly objects to dollars and cents being introduced. He refers to "the continual onslaught of the commercial man for the sake of cheaper and therefore poorer machinery." "Cheaper and *therefore* poorer" must sound rather prehistoric to an American manufacturer. Quoting again, "although dishonestly designed and manufactured machinery may yet be successfully sold for a time by an acute salesman such conditions cannot last." If there is one thing more than another which has placed this country in the foremost position in the manufacture of machinery it is the constant endeavor to reduce the cost of production, and to characterize the cheap manufacture of machinery as dishonest is too ridiculous. The method of manufacturers has been, first of all, to decide what the market standard requires and then to build the cheapest machine that would do the work. This has been the business policy of the country for over twenty years, and if this is dishonest surely we would have heard about it before. Mr. Behrend says: "imagine the equipment of a man-of-war to be made in the cheapest possible manner." The comparison is unjust; the requirements for a man-of-war are the best ship and equipment that can be built, regardless of cost; even the best that can be made is not capable of doing the work required of it. With ordinary commercial machinery the requirements are much less severe. It is quite simple to produce a machine that will satisfy the requirements as regards performance, and the only question is how cheaply it can be produced. The consumer unconsciously sets the market standard. It is the old question of first cost against cost of operation. We can build a 10-hp motor with an efficiency of 90 per cent and a temperature rise of 15°, but the purchaser would say that such a motor is not worth the 25 per cent more which it would cost him than one with an efficiency of 86 per cent and a temperature rise of 40°, so he unconsciously sets the market standard at this latter figure. And so it is with every line and size of machinery from a 10,000-hp steamship to a fan motor. The problem is to design and manufacture the cheapest machine that will fill the specification.

Quoting Mr. Behrend again, "speaking for the moment with particular reference to the electrical engineer and his work, I would say that while he shows his ability in designing a 10,000-kw generator with the amount of material used five years ago for a 5,000-kw generator, he simply could not have formerly designed a 10,000-kw generator at all ***until he had learned*** how to use the material at his disposal to better advantage." I have emphasized the words "until he had learned" because they offer an explanation of the position taken by some engineers. Engineering capability is a combination of natural genius and education and of experience, and the greater the engineer's natural ability the less he feels the necessity of proceeding cautiously and waiting for a practical demonstration of the correctness of every step before proceeding to the next one. Almost any engineer can design machinery by an endless trial and error method. But as I once heard a celebrated engineer remark, "there is such a thing as having too much experience and too little sense."

Where would we have heard of such engineers as Brunel, Stephenson, Siemens or Westinghouse if they had not the ability or genius sufficient to confidently make radical departures from existing types? Of course, it is hardly fair to compare the ordinary constructing or designing engineer with such men, especially as commercial conditions are now so different. In the present day when there are only too many engineers waiting to profit by the mistakes of those ahead of them, it takes a great deal of courage to assume the risk of failure which we must often do when we make any decided departure from existing methods. So if an engineer is not quite confident in his ability, if he is a little timid or inclined to be easy going, there is nothing that appeals to him more than to follow standard practice or to proceed slowly and cautiously and to verify by experiments every little step before proceeding to the next. This is a state of affairs among engineers which is difficult for a firm to contend with, and it is usually this condition of things which is responsible for the lack of progressiveness of large firms and not, as Mr. Behrend says, the desire of manufacturers to keep to standard machinery to the exclusion of improvements.

Mr. Behrend deplores the introduction of commercialism into engineering, but he forgets that if it had not been for this introduction of commercialism and for the employment of engineering talent by business interests that engineering science and practice would never be where it is to-day. Steam turbines, steamships, the telegraph and telephone, electric railway and light systems all owe their existence as much to commercialism as to engineering knowledge. And strange as it may seem to Mr. Behrend, those concerns which are most enterprising in a commercial way are the very concerns which are always the first to introduce improved designs and methods. I can agree with and endorse in almost every detail Mr. Behrend's criticism of the superficiality and incompleteness of modern academic engineering education, but I cannot agree in his remarks con-

cerning commercial engineering. Instead of saying that manufacturers who try to make cheaper and more modern machinery are dishonest because they occasionally make a mistake, I would say that the engineer who was employed by a firm to assist in the design and manufacture of cheaper and more modern machinery was dishonest if he refused to do this to the best of his ability and to accept cheerfully the necessary risk. It is popular nowadays to deride commercialism and the trusts, but engineers should be a little more independent in their opinions; they should remember the debt engineering owes to commercialism and they should remember that the reason why every new engineering idea is now taken up and pushed so strenuously is that this modern commercialism is of necessity progressive. Realizing all these things, engineers should be a little more just in their criticisms and opinions of modern commercialism.

MILWAUKEE, WIS. W. L. WATERS.

To the Editors of Electrical World:

SIRS:—Mr. Waters' error in attributing to me opinions which I do not hold is due to his misinterpreting my definition of the work of the engineer, and to his wish to raise an issue where there is none. To avoid misunderstanding I, therefore, proceed to explain the controverted sentence: "The work of the engineer should consist in the careful designing and building of apparatus so that it performs its functions safely and with the least possible waste of both material and power."

The engineer par excellence is he whose machines are designed simple and inexpensive, both as regards labor and material, and possess the qualities essential to safe and satisfactory operation, as high efficiency, low heating and other good characteristics. He who effects the best compromise among these occasionally conflicting conditions is the engineer of my choice.

Regarding Mr. Waters' comments on my alleged views that "dollars and cents are not to be considered," and that "reducing the cost of production is dishonest," I dare say they are fictions of his own, which I am unable to trace to my paper. He, like Don Quixote, has set up for himself imaginary foes whom he delights in demolishing. The principles which I endeavored to inculcate in my paper have been tested in the arena of competition, and my business managers have, for now well-nigh seven years, not despaired of my staff, as Mr. Waters will have it, but built up a very large concern and paid their dividends with unfailing regularity.

NORWOOD, OHIO. B. A. BEHREND.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Size and Safety of Turbo-Alternators.—KINGSBURY.—The weight of a high-speed turbine-type alternator outfit is about one-sixth of the weight of an outfit of corresponding capacity driven by a compound engine. A more detailed comparison may be made by taking the cases of a 3,000-kw turbo-alternator running at 1,500 r.p.m., and an alternator of the same capacity running at 75 r.p.m., driven by cross-compound condensing engines. The total weight of the turbine unit, exclusive of condensing apparatus, is about 160,000 lb. The total weight of the reciprocating engine and generator without auxiliaries is about 1,200,000 lb. The fly-wheel alone of the compound engine weighs 320,000 lb., or twice as much as the entire turbine unit. The 37-in. hollow shaft of the reciprocating engine weighs 130,000 lb., or nearly as much as the entire turbine unit, and has very nearly the same diameter as the rotating field of the turbine generator and a section of this shaft 50 in. long represents the entire volume of the turbine generator field; or again, the 16-in. hole in the shaft of the reciprocating engine represents very closely the volume of the rotating field core of the turbine generator. Instead of being an additional danger in a power house the turbo-alternator rather gives a higher degree of safety. The rotating part is small compared with the fly-wheel of the corresponding reciprocating engine. Moreover, the rotating part of the turbo-generator is contained in a thick shell of laminated steel which is exceedingly tough and capable of absorbing enormous shocks. The boiler is rather a greater danger than the turbo-alternator.—*Elec. Jour.*, January.

Interpole Machines.—PELIKAN.—An account of an investigation of the theory and construction of machines with commutation poles. The special flux of the commutation poles passes solely through the latter, if they alone are excited. If, however, the machine is loaded, the commutating flux passes through the neighboring main pole of opposite polarity. The flux in the main poles remains unchanged from no load to full load, but the flux in the armature iron and the yoke varies. There is no advantage in giving a special shape to the commutation poles. Various equations are given relating to the theory of interpole machines.—*Elek. Zeit.*, January 10.

Carbon Brush Holders.—MILLS.—There are two types of carbon brush holders, first the sliding type, in which the carbon is held or guided in a fixed position by means of a retaining box, and second the clamp type, in which the carbon is bolted or clamped rigidly to a pivoted support. The sliding type finds its greatest field in motor work, for instance in traction. The carbon holders of the clamp type generally find their best application where it is necessary to carry relatively heavy currents as this type of holder has higher current carrying capacity owing to its conductivity being improved by bolting or clamping the carbon to the main part of the holder.—*Elec. Jour.*, January.

Resonance Transformers.—BENISCHKE.—A resonance transformer is one the secondary circuit of which contains a condenser. This arrangement has been used for some time in wireless telegraphy. Approximately the same is the case with a transformer the secondary of which is connected to a cable. The author gives the mathematical theory of the operation of such transformers.—*Elek. Zeit.*, January 10.

Commutator Motors.—LATOUR.—The first part of a mathematical article on the properties of commutator motors. The object is to give a more detailed theory with less simplifying assumptions than has so far been given.—*L'Eclairage Elec.*, January 5.

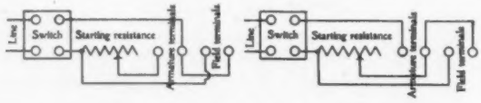
Lamps and Lighting.

New Incandescent Lamps.—Two further articles of this serial, the first installment of which was recently abstracted in the Digest. The author gives some information on zirconium, iridium, tungsten, molybdenum and graphitized carbon filaments, all of which have already been dealt with in our columns. In comparing the different lamps with each other it is pointed out that a true comparison is possible only when all of the conditions and requirements of the tests are taken into account. The different tests of the different lamps have not been made under the same conditions. After the incandescent petroleum lamp the incandescent gas lamp is cheapest, and as an indication of the growth of gas lighting it is stated that in the year 1859 the number of cubic feet of gas used for lighting was 1,400 millions, while it is now 28,250 millions. In spite of its expensive working, the electric incandescent lamp has found an extraordinary dissemination. It seems certain that all the new filament lamps are cheaper than the carbon filament lamp. The Nernst lamp with half its consumption and with the possibility of using high voltages is handicapped by the necessary preliminary heating and resistance coil for the glow rod, which makes it expensive to manufacture. The osmium lamp is also

expensive, can be used only with low voltages and must be suspended in a vertical position. The tantalum lamp is equally efficient as the osmium lamp; it can be fixed in all positions, but, while careful provision against vibration is at first not very necessary it is essential later on. "The present considerably reduced price and the higher voltage of the tantalum lamp give it an advantage over the osmium lamp. Unfortunately, the tantalum lamp is not suitable for alternating current, and it is, extraordinary that with it the recently manufactured lamps seem to last much less time than when they first appeared. The cause of this most unusual occurrence has not yet been made known." (In a foot note the technical supplement of a Berlin daily paper is given as authority for the statement that "the tantalum lamps have recently been much improved and are now also adapted for use with alternating current. The average life of the 25-cp lamp amounts to from 300 to 400 hours, and the 50-cp lamp from 500 to 600 hours. The lamps are already being used with alternating current.") Zirconium and iridium lamps are made at present for low voltages only. With respect to the tungsten lamp, the high claims made for it are mentioned, but it is pointed out that "in all countries where an examination of patents in respect to novelty takes place, particularly in Germany and Austria, none of the patent applications except the first one by Just have up to the present been accepted. It is yet to be seen which of the various processes can secure effective protection by patent, and it is not yet known which of them in practice will produce efficient lamps." Concerning the Cooper Hewitt mercury vapor lamp it is said that its efficiency corresponds to the best results yet attained with flame arc lamps. With reference to the permanence of the lighting power, and the steadiness of the burning the mercury vapor lamp has not yet been beaten, particularly as somewhat considerable changes in voltage are without influence. The chief merit of the mercury lamp, however, consists in the fact that no attention and no regulating is necessary, and that the illuminating power, as far as the experiments have yet reached, remains unaltered. The life of the Hewitt lamp, when carefully handled, leaves little to be desired. The chief obstacle of the mercury lamp is the green color of the light.—*The Engineer* (London), December 14 and 21.

Power.

Faulty Motor Connection.—Latta.—A note pointing out that while few electric circuits are less complex than that required for supplying power to a shunt-wound direct-current motor, yet a certain faulty connection is quite often made. With certain types of motors this connection is so much like the correct circuit in appearance that the operator is often very much puzzled when a machine connected up in this way fails to start properly. Fig. 1 shows a diagram of connections for a correct



FIGS. 1 AND 2.—FAULTY MOTOR CONNECTIONS.

circuit for supplying power to a shunt motor. This circuit is correct regardless of which side of the power lines is positive. By reversing the connections at the armature terminals the circuit represented in Fig. 2 is obtained, which is a diagram of the faulty circuit referred to above. In starting a direct-current motor, it is the usual practice to make sure that the field circuit is completed before any current is put into the armature. A motor connected as shown in Fig. 2 will show the normal field current, but when an attempt is made to bring the motor up to speed the armature will run at a dangerously high speed and may "buck over" at the commutator before the starting box lever has been rotated to the position of full-speed running. If the load at starting is very small, the motor may start even before the armature circuit is closed. An examination of Fig. 2 will show that the starting resistance and the motor field coils are connected in parallel. Hence, as the starting resistance is cut out the field coils will be short-circuited. As the speed of a motor depends on the field strength, it is apparent why the motor runs too fast when an attempt is made to start it.—*Elec. Jour.*, January.

Suction Producer Tests and the Indicator.—An editorial discussion of the recent trials of suction gas producers, carried out by the Royal Agricultural Society, with special reference to the application of the Mathot indicator and recorder. The instrument resembles an ordinary high speed indicator, with the difference that it has the usual pencil-carrying arm extended both right and left so that it can carry two pencils in place of one and, in addition to giving the usual diagram, record the up-and-down motion of the indicator piston on a slowly rotating drum; each explosion and expansion is represented by one vertical line. Between consecutive explosions the drum rotates a fraction of an inch, thus producing a series of vertical lines; if the engine cuts out for one or more strokes, the long lines are replaced by short ones, proportional to the pressures of compression. This effect is easily seen and understood on reference to the diagrams contained in the report. Primarily, the use of the instrument is that it forms an automatic record of the number of explosions per minute, and of the way in which the governing gear is working. The writer doubts if the instrument can show anything more. While it is useful for certain measurements, it would be unfair to build on its records elaborate theories or deductions as to what is going on in the cylinder of an internal combustion engine.—*The Engineer* (London), December 28.

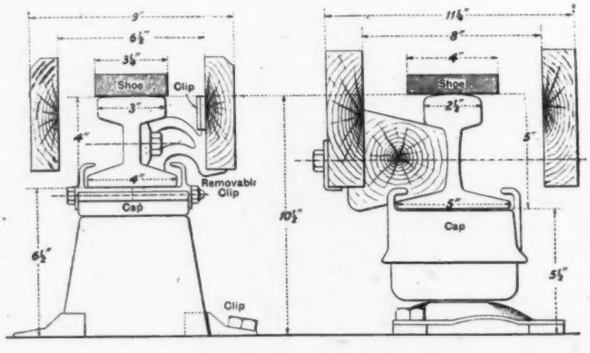
Water Gas.—Jüptner and Nagel.—An article on the production of water gas. Numerous tables and diagrams are given on the composition of water gas at different temperatures and pressures. The best conditions for making water gas in practice are then discussed.—*Electrochem. and Met. Industry*, January.

French Water Power Stations.—Montpellier.—A statistical article, illustrated by maps, on electric generating stations in the Province of Savoy, which is often called the "White Coal District" on account of its abundant water powers. It is the seat of electrochemical and electrometallurgical industries. Of the 27 power stations in Savoy, only one is operated by steam power. Twenty-one stations produce direct current, one single-phase alternating current, three generate three-phase current, and in one (which supplies power to the city of Lyons) the high-tension direct-current series system of Thury is used.—*L'Electricien*, January 5.

Thury System.—Reyval.—The first part of an illustrated description of the power transmission system from Moutiers to Lyons in France by means of the high-tension, direct-current series system of Thury.—*L'Eclairage Elec.*, January 5.

Traction.

Third-Rail Construction.—Goolding.—A note on certain defects found in third-rail construction. The section mostly in



FIGS. 3 AND 4.—THIRD-RAIL CONSTRUCTION.

use is the tee or Vignoles section shown in Fig. 4. Instead of it, the author recommends the new section shown in Fig.

3, which was selected for use on a large system, on account of the advantage of compactness, while the two sections are of about the same weight and area. The author then refers to the advantages of using malleable cast-iron brackets for supporting the wood protection. To provide for expansion and contraction the Lancashire and Yorkshire Railway allows an expansion joint every 80 yards of conductor rails, all the intermediate joints being bolted hard and fast, and each of these lengths is also anchored. The practice of allowing play at every joint is unsatisfactory, since with long lengths the rail is liable to creep along and crowd up to one end. The author finally describes a method of sectioning the conductor rail for single line working.—Lond. *Elec.*, January 11.

Buffalo Meeting.—A full detailed account of the proceedings at the Buffalo meeting of the Street Railway Association of the State of New York with reprints of the papers presented at this meeting.—*St. R'y Jour.*, January 19.

Installations, Systems and Appliances.

Sub-Station.—PARKER.—An illustrated article on the sub-station of the Lackawanna Steel Company in which power transmitted from Niagara Falls is transformed for the needs of the steel works. The sub-station is to co-operate with the old power plant in which blast furnace gases are used to drive gas engines coupled to generators. Since the supply of blast furnace gas was not sufficient for the demand of power in the steel works the transmission from Niagara became necessary. The new electrical equipment, in general, consists of four stations; the sub-station containing transformers which decrease the e.m.f. from 60,000 volts to 2,200 volts; and three feeder stations, which receive the electricity at 2,200 volts at as many different points in the plant and there convert it to 440-volt, alternating-current and 250-volt, direct-current. The chief object in design was to attain the highest degree of reliability by using absolutely simple and fool-proof apparatus. The simple high-tension winding, the use of a transfer truck instead of a crane, the omission of barriers between or pits for the transformer units, the oil piping system and the duct structure between the stations all make for the simplicity of the installation. Of special interest is the method used to improve the power factor. The present direct-current load at the steel plant is much in excess of the alternating-current load and the plant load factor is very good. The alternating-current power-factor, however, is not very high as the equipment consists of relatively small induction motors, many of them running at only fractional loads most of the time and starting frequently. The power factor is improved by the use of synchronous motor-generators. As the 250-volt distributing system of the Lackawanna Steel Company offers a common connection between all the generators in these sets it was desirable to find some means of apportioning the load between various stations so as to keep as high an equipment load factor on the converting apparatus as possible. As it is desired that the draft of power from the Ontario Power Company's generating plant shall be free from peaks, the Lackawanna Steel Company will operate part of its present equipment in parallel with the transmission line. For this reason, as well as for the equalization of loads on the various machines, it was desired that the voltage of the converting apparatus should be above the voltage of the original plant of the Lackawanna Steel Company up to a point representing normal load on the former machines, and that the voltage should then drop to a value below that of the old plant; that is, the regulation of the new installation should be purposely made rather poor above a certain value of load. Below this point the Niagara transmission will tend to take all of the load, but no additional load above this point.—*Electric Journal*, January.

Synchronous Apparatus for Improving Power Factor.—LINCOLN.—An editorial note with respect to the use made at the Lackawanna Steel Co.'s plant (see above abstract) of synchronous machines to correct for the wattless power demanded by the load. An alternating-current circuit requires "a certain amount of magnetism" which must be supplied from synchronous machines. The higher the voltage and the lower the power-factor of a given load, the greater must be this amount of magnetism. The amount of magnetism required in a given case may be measured by the so-called "wattless component." An induction motor, for instance, taking 80 real kw at 80 per cent power factor takes from the circuit a total of 100 k.v.a., of which the wattless component is 60 k.v.a. In other words that motor takes 60 k.v.a. of magnetism which must come from some synchronous apparatus. At the Lackawanna Steel Company's plant, for instance, were it not for their over-excited synchronous apparatus, this 60 k.v.a. of magnetism would have to be put into the system by the generators at Niagara Falls, thence transmitted through the various transformers and transmission lines until utilized. The synchronous apparatus that has been installed, however, makes it possible to put in at least a part of the required magnetism close to the point needed. As long as synchronous apparatus operates at a lagging wattless current it is receiving a part of its magnetism from some outside source. At unity power factor it is just supplying its own needs. As soon as its field magnetism is forced above this point it generates, so to speak, an excess of magnetism which becomes available for neutralizing the lagging wattless component of current demanded by induction motors and similar apparatus.—*Electric Journal*, January.

Wiring of Small Central Stations.—SINCLAIR.—A great responsibility develops on the erecting engineer in connection with the installing of cables, small wiring and accessories in central stations and isolated plants of small and medium size. The author gives useful rules as to the location and support of the switchboard, choice of size and method of support of generator cables and feeders, the lighting of the station and the installation of motors, starters, controllers and protective devices.—*Elec. Jour.*, January.

Paris Power Station.—An illustrated description of the St. Denis power station in Paris of which only the first portion has been installed, but which promises to become one of the most modern European plants with its 12 turbine units of 6,000 kw and its modern coal handling and boiler installations. The plant is largely utilized for electricity in bulk to the Metropolitan Railway.—Lond. *Elec. Rev.*, January 11.

Coaling Tower.—An illustrated description in great detail of the coaling tower of the new Waterside station in New York. *Eng. Record*, January 19.

Electro-Physics and Magnetism.

Change of Elastic Constants by Magnetization.—HONDA AND TERADA.—The elastic constant of a substance in a magnetic field is defined as the ratio of the stress applied to the strain caused thereby, the magnetic force constantly acting on the substance. The change of elasticity is then the difference of this quantity, when the magnetic field is on, and when it is off. The authors have made extended researches on this change in various ferromagnetic substances. In Swedish iron and tungsten-steel the change of elastic constants is generally positive, but its amount is extremely small, while it is remarkably large in nickel. The difference of the results obtained by direct and indirect methods was also studied.—*Phil. Mag.*, January.

Impulsive Motion of Electrified Systems.—SEARLE.—A highly theoretical paper. When an electrified system is suddenly set into motion, a pulse of electromagnetic disturbance travels outward from the system in all directions with the velocity of light, and this pulse carries energy and electromagnetic momentum away to infinity. In the present paper a method is given of calculating the radiated energy and momentum for any given system, and the results are applied to a number of simple systems. The principles of electromagnetism are then applied to deduce the electric and the magnetic energies and the momenta of the systems when they are in steady motion.—*Phil. Mag.*, January.

Induction Between Parallel Wires.—SHEPARDSON.—A mathematical paper giving the theory of self-induction of two parallel wires; mutual induction between parallel wires; self-

induction of a three-wire, three-phase circuit, and drop in three-phase lines.—*Year Book, 1906, Engineers' Soc. Univ. of Minnesota.*

Electro-Chemistry and Batteries.

The Electric Furnace in Iron and Steel Metallurgy.—Abstracts of five recent papers on this subject. Hutton, in a paper before the Sheffield Society of Engineers and Metallurgists, discussed the whole situation. Concerning electric reduction of iron ores he referred to the Soo experiments of Haanel and Héroult and urged that England should interest itself in the development of its colonies. "In Canada far too much is left to the enterprise and capital of the United States." Of electric steel processes the induction-furnace process of Kjellin and the process of Héroult are specially discussed. "Should the Héroult steel process succeed in justifying its claims, there is no doubt that it would be the greatest advance in the general principles of steel manufacture which has been brought forward since the introduction of the basic system." A paper by Eichhoff describes the Héroult process, as operated in Remscheid, Germany. The plant was started in February, 1906, and is now to be doubled. Two papers by Roechling and by Härden deal with the induction furnace, the latter discussing especially the construction of Kjellin. A paper by Evans describes laboratory experiments on making steel directly from titaniferous iron ores.—*Electrochem. and Met. Ind.*, January.

Carbon Cell.—Patterson.—An account of experiments confirming the view of Haber that the so-called Jacques carbon cell is in reality an oxy-hydrogen cell. Some calculations are then given which show that such distinct cases as the "carbon cell" and the dissociation of water vapor at high temperatures are governed by the same thermodynamic relation. The reason is that they are both consequences of the free energy of the formation of water vapor from its elements.—*Phil. Mag.*, January.

Units, Measurements and Instruments.

Practical Photometry.—Harrison.—A paper read before the Leeds section of the (British) Inst. of Elec. Eng. on practical photometry and its value. The best way to obtain a standard for practical purposes is to use an ordinary carbon lamp of low efficiency. This should be a lamp with a large clear spherical bulb and should be continuously run for about 200 hours to get over the rise and fall in cp which occurs in the initial stages with nearly all carbon lamps. Sub-standards of much more permanent cp, such as the osram lamp, can be kept in continuous use for general testing of any type of lamp. For testing carbon lamps only, a carbon lamp of similar voltage is the most satisfactory. The author then gives a review of photometers for practical use and describes his own portable universal photometer which has already been noticed and illustrated in the Digest. A compact arrangement for measuring the consumption of incandescent lamps and indicating the same in watts per cp has been devised by Wilson and Hardingham and is indicated in Fig. 5. The general principle of this

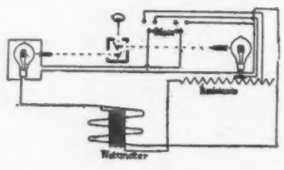


FIG. 5.—PRACTICAL PHOTOMETRY.

arrangement is as follows: A variable resistance is connected in series with the shunt coil of the wattmeter in the circuit of the lamp to be tested; this resistance is in the form of a sliding rheostat, the lamp to be tested being attached to the slider. This is a boxed form of photometer, and the photometric balance with a previously tested lamp is obtained by sliding it backwards and forwards. The resistance of the rheostat is calibrated so as to increase or decrease the reading on the wattmeter in such a way as to make it read watts per candle power. Contact keys are provided for reading watts consumed, should this be desired; and the candle-power can also be noted. —Lond. *Elec. Rev.*, January 11.

Cymometer.—An illustrated description of the Fleming direct-reading cymometer and its applications. The instrument consists of a sliding-tube condenser which is joined in series with

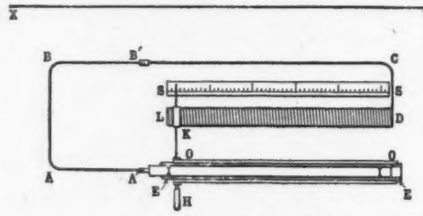


FIG. 6.—CYMOMETER.

a variable inductance coil (Fig. 6). These two elements are so connected together that one movement of a handle, *H*, varies simultaneously and in the same proportion the capacity of the sliding condenser, *OI*, and the inductance of the part of the coil, *LD*, in circuit. The circuit of the condenser and the inductance coil are completed by a thick copper rod, *ABC*, and it thus forms what is known as a closed oscillatory circuit, the capacity and inductance of which can be varied simultaneously and in the same proportion over certain limits. If such a circuit is placed in contiguity to another circuit, *XY*, for example, the antenna of a wireless telegraph transmitter in which high-frequency oscillations exist, these last tend to induce in the cymometer secondary oscillations, but the amplitude of these secondary oscillations is extremely small unless the circuit of the cymometer is tuned or adjusted to that of the primary circuit in which the oscillations are taking place. If, however, this adjustment is exactly made, then the primary oscillations create secondary oscillations in the cymometer circuit of great amplitude; in other words, set up a powerful secondary current in the cymometer circuit. This adjustment is effected by moving the handle, *H*, of the cymometer, thus causing the tube or tubes which form one surface of the condenser to slide more or less off an ebonite tube which encloses other metallic tubes forming the second surface of the condenser, and at the same time inserts more or less of a spiral of wire into the circuit. The adjustment which is necessary to secure this precise tuning between the cymometer circuit and the circuit under test is recognized by the employment of a neon vacuum tube connected between the inner and outer surfaces of the sliding tube condenser. Neon is one of the rare gases contained in the atmosphere and a glass tube filled with rarefied neon constitutes an extremely sensitive means of detecting high-frequency electric oscillations, as the tube glows with a brilliant orange when the platinum terminals are connected to two points on the circuit in which such oscillations are taking place. The latest construction of the instrument as used in practice is then described and instructions are given for using the instrument for the following purposes: To determine the frequency of the electric oscillations in any circuit; to determine the capacity of a small condenser or Leyden jar; to determine the inductance of a coil of wire; to determine the length of the waves given off by a wireless telegraph apparatus.—Lond. *Elec.*, January 11.

Recalibration of Instruments.—Ramakers.—An article on the necessity of and methods for recalibrating electrical measuring instruments from time to time. The method of the Weston Company of calibrating voltmeters with the aid of a standard cell, a galvanometer and resistances is described. A simple modification of this method for the calibration of millivoltmeters is then given. Then follow detailed descriptions, illustrated by diagrams, of different arrangements of the instruments and connections for such tests.—*Soc. Belge d'Elec., Bull. Mensuel*, January.

Motor-Driven Forge Blower.

The accompanying illustration shows a form of motor-driven forge blower, the distinctive features of which are as follows: The blower wheel is mounted directly on the armature shaft; the blower casing is a part of the motor frame and carries one of the two bearings. The speed controllers are provided with means for insuring that the desired strength of blast will be obtained. Thus the energy consumed depends upon the amount of the blast and the time it is in operation; the motor being stopped when the blast is not required.

The motors are wound for direct or alternating currents in three sizes suitable for horse shoers' fires, wagon makers' fires

MOTOR-DRIVEN FORGE BLOWER.

and the large forges used in railway shops. Blowers of this type are also largely used for oil furnaces, gas furnaces, in starting gas producer plants and many other places where low pressure blast is required. They are manufactured by Roth Bros. & Co., Chicago, Ill.

Telephone Junction Boxes.

Mr. Frank B. Cook, of Chicago, is putting out a new telephone cable junction box made of sheet steel, heavily galvanized. This construction renders it very much lighter than the old painted cast-iron boxes. The difference in weight is so great that it will effect a material saving in freight. It also makes it much easier to handle on the pole. It furnishes a most economical and simple means for installing and splicing main leads of cable and extending branches of smaller cable to other distributing points. It renders sleeve splicing or wiped joints unnecessary. It makes cable testing a very simple matter, as the box can be opened more easily than can a cable joint. It is absolutely moisture-proof, and has a sliding galvanized sheet metal cover, which furnishes added protection. The junction box is equipped with self-soldering nozzles, and is made, as noted above, of galvanized sheet steel, a rubber gasket rendering the joint between the cover and the box moisture-proof. The box is galvanized after being formed up, so that the galvanizing will fill all the joints and make the box air-tight. In order to make sure that the joint is moisture-proof the box is subjected to an air pressure test before leaving the factory.

The bottom of the box is about 2 in. deep so that paraffine or a compound may be poured in to that depth, after the cable has been brought in and spliced. This is an additional protection to the cable against moisture. The box can be furnished separate or combined with terminal if desired. One new and original feature of the box is that it may be installed alone originally and the terminal can then be added at any future time.

All boxes are equipped with self-soldering nozzles. Self-soldering nozzles are a great convenience and are really very economical, as they save the services of an expert cable splicer or of a plumber to make wiped joints. All that is necessary is to scrape the lead cable sheath bright and clean before inserting it in the nozzle. To solder the cable to the nozzle a blow torch is applied to the outside of the nozzle, first wrapping tape or paper around the bottom of the nozzle to prevent the solder from running out. The necessary amount of solder and flux is inside of each self-soldering nozzle.

Toggle Bolts.

If ordinary wood screws held firmly in hollow tiling, electrical contractors doing work in modern buildings would find their work somewhat simplified; but the crumbling of the tiles makes the use of screws prohibitive. The next best method is to punch a hole in the tile with a screwdriver and insert a so-called toggle bolt, i. e., a bolt having a pivoted bar or head-

FIG. 1.—TOGGLE BOLT.

piece to catch inside the tiling. The bolts commonly used for this purpose have the anchoring bar pivoted to the head of each bolt, so that tightening the device exposes the surplus of thread. If this is cut off it still exposes the rough end of the bolt and the square nut, neither of which make a finished looking job. Besides, it takes time to cut off the extra thread, and with the present high cost of labor this means quite an item of expense.

To save this labor and to give the work a neater finish, the new type pictured herewith has been devised by Mr. Albert Scheible and is being marketed as the "Ajax" toggle bolt. Unlike the older forms, it has the head-piece (which is U-

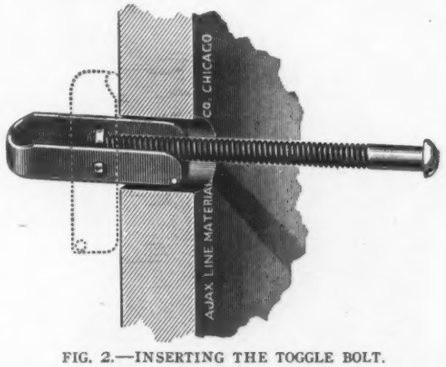


FIG. 2.—INSERTING THE TOGGLE BOLT.

shaped) pivoted to the nut, with an ingenious provision for keeping this head parallel to the bolt when it is being inserted as shown in the larger of the cuts. Then a half turn of the bolt drops the head across the opening, so that the bolt can be quickly tightened, leaving the screwhead exposed, while the surplus of thread is hidden in the wall. The new bolt is made in eight sizes by the Ajax Line Material Company, of Chicago.

Large Engines Operated by Blast Furnace Gas.

There was placed in operation at the Edgar Thompson Works of the Carnegie Steel Company, Pittsburg, beginning with December 7, what is stated to be the first installation in America using blast furnace gas and double-acting, four-stroke-cycle gas engines of large capacity. This engine represents the first of a series of twelve 3,000-hp units that are now being built by the Westinghouse Machine Company. It is of twin tandem double-acting style with center hung flywheel and with two air tubs arranged in "vis-a-vis" fashion opposing the two engine frames

The gas cylinders are 38 in. in diameter by 54 in. in stroke, and the air cylinders are 60 in. in diameter; the normal speed is from 60 to 75 r.p.m. Engines of the same size are being constructed for electric work in which case the air tubs are removed and a generator is mounted upon the shaft next to the flywheel. The generator will have a rated capacity of 1,500 kw running at 75 r.p.m. Such a unit is now under construction for the Edgar Thompson plant. The generator will be directly coupled, and will deliver direct current at 250 volts.

High-Tension Magneto Ignition System.

One of the greatest disadvantages registered against the magneto system of ignition for automobiles relates to the fact that, as ordinarily applied, a battery must be installed for use during the initial starting period. The system described below overcomes this disadvantage so effectively that a spark sufficient for ignition is obtained at the slowest speed at which it is possible to "crank" the machine, while the spark produced at the highest speed is of practically the same intensity.

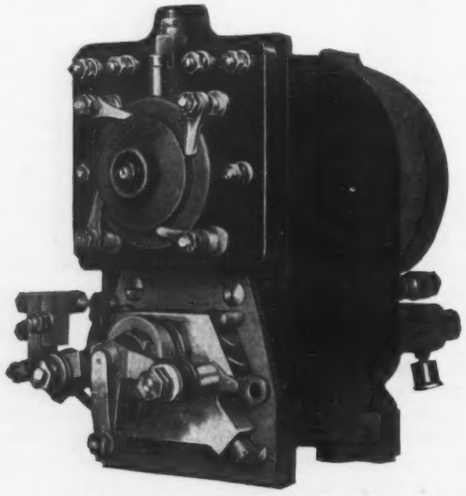


FIG. 1.—HIGH-TENSION MAGNETO.

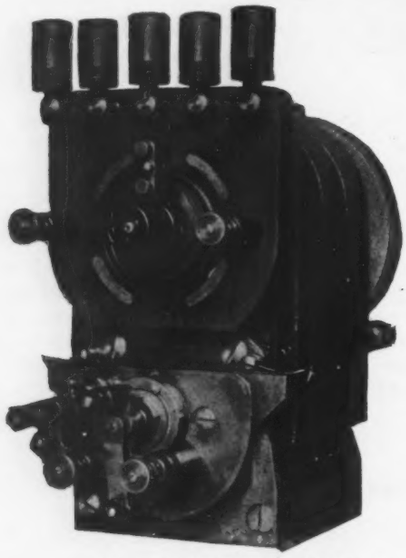


FIG. 2.—HIGH-TENSION MAGNETO.

The generator which supplies the electrical energy for ignition differs inappreciably from the usual magneto; a powerful permanent field is produced by six horseshoe magnets fitted in three pairs, while the armature is of the ordinary bipolar form, and is provided with an extra large number of turns. Thus the generator is designed for high tension. The operation of the ignition system depends, however, not so much upon obtaining a high voltage directly from the generator as upon the method by which the electrical energy from the generator is utilized. When the circuit from the armature is properly completed, current flows from the generator to the primary winding of an open iron magnetic circuit transformer, in the field of which is thereby stored a certain amount of magnetic energy. When the magneto armature circuit is suddenly interrupted, the stored magnetic energy is discharged largely into the secondary winding of the transformer which is provided with an extremely large number of turns, so that the energy is delivered to the secondary circuit at very high voltage. Within the secondary circuit is inserted one or another of the spark-gaps according to which one of the engine cylinders is in position to have the compressed gas exploded. The selection of the gaps at the proper position of the various cylinders is made by means of a distributor which, with the armature of the magneto generator is driven synchronously with the engine shaft. The above outline covers the fundamental features of the ignition system, the details of which are further described below. The component parts are so designed and adjusted that the rapidity of break in the generator armature circuit is independent of the speed, while the voltage ratios are so chosen that the magnetic energy stored at the lowest possible speed produces sufficient secondary e.m.f. to give a spark for ignition, and no storage battery or other supplementary ignition system is required for starting.

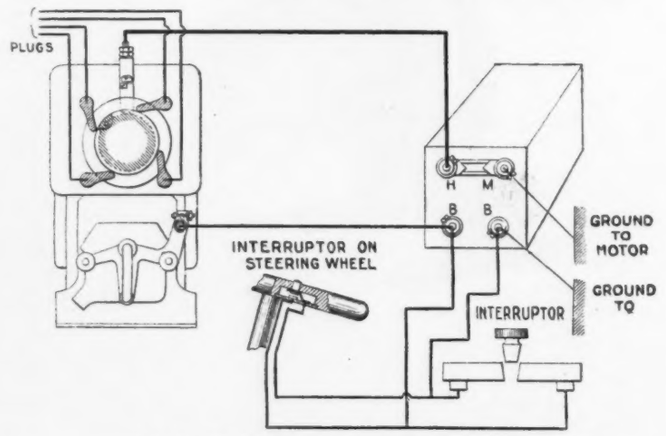


FIG. 3.—WIRING DIAGRAM FOR IGNITION BY MAGNETO.

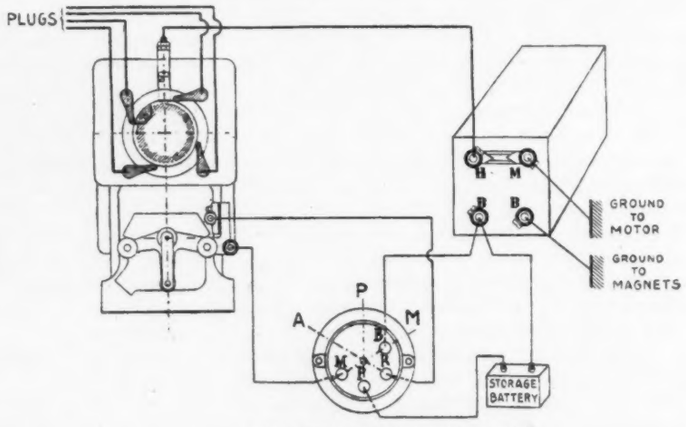


FIG. 4.—DUAL IGNITION SYSTEM.

Views of the magneto generator showing the low-potential contact mechanism and the high-potential distributor is given in Figs. 1 and 2. One terminal of the generator armature winding is connected directly to the armature core, while the other passes to an insulated copper bolt which is mounted within the hollow shaft. A carbon brush serves to complete the circuit

from the bolt to the low-potential contact device. By means of a cam mounted on the armature shaft the circuit is closed at the contacts whenever the armature reaches a definite position with reference to the field poles, and the contacts are rapidly separated when the armature has advanced through a certain arc. The contact pieces are shunted by a condenser of suitable capacity, so that sparking between them when they are separated is reduced to a minimum.

Across the terminals of the secondary coil of the transformer is arranged a safety spark-gap, adjusted at from 7 to 8 mm., which serves to protect the coil from extra high potential in event a circuit to one of the cylinders becomes broken; any arcing across this gap indicates at once that at least one of the cylinder gaps is not operating properly. See Fig. 3.

Although the above-described magneto ignition system is intended for use without any auxiliary ignition device, there are automobile owners who prefer to have available a duplicate ignition system for use in case of accident to the magneto. The demand of such owners is effectively met by installing merely a set of batteries, the transformer coil of the magneto ignition system serving admirably as the induction coil of the battery ignition system. In case of dual ignition a three-way switch allows the spark plugs to be connected to the battery system, the magneto system or "off" as may be desired. See Fig. 4.

The Eisemann-Lavalette high-tension magneto and dual ignition equipments, as described above, are manufactured by Lavalette & Co., of Paris. They are handled in this country by Lavalette & Co., 16 East Forty-second Street, New York.

More Notes on the Chicago Electrical Show.

The Chicago Electrical Show, conducted by the Electrical Trades Exposition Company, of Chicago, closed January 26. This was the second annual exhibition of the kind held in Chicago. When the company was first organized to hold the 1906 show there was considerable doubt in the minds of many electrical men as to the success of such a show and as to whether it would pay electrical manufacturers to exhibit. The object of any trades exposition of this kind is, of course, to further the sale of goods. In the case of the Chicago Electrical Show two classes of visitors had to be considered: First, electrical men from surrounding States who are possible purchasers of electrical supplies, and second, the general public which it is desired to interest in the various applications of electricity. The 1906 and 1907 shows have been remarkably successful in attracting both classes of visitors. The general sentiment among exhibitors seemed to be that it paid them well to exhibit. In fact, the Chicago Electrical Show seems now to be established as a recognized winter gathering place for electrical interests from all over the great Middle West.

The electrical jobbers, the electrical salesmen, the Northwestern Electrical Association, the Rejuvenations of the Sons of Jove and numerous other minor gatherings were held during the two weeks of the show and many came who were not called by anything but the fact that the show was in progress.

THE attendance for the 12 days and 13 nights the show was open was about 105,000.

Managing Director Homer E. Niesz is already taking applications for space at the next show, which will be held in January, 1908. Following are notes on some of the exhibits which have not been mentioned in previous issues:

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, of Chicago, made an exhibit of some of the principal electrical supplies carried by it.

ELLERY'S BAND gave concerts afternoon and evening. Seats in the gallery were free for all who wished to rest from sightseeing and hear the music.

THE AMERICAN VIBRATOR COMPANY gave vibratory and massage treatments to visitors with its very neat little vibratory motor which is of a size and cost adapted for use by the general public.

THE DIEHL MANUFACTURING COMPANY made a special exhibit of sewing machine motors both for home and factory use. To illustrate the latter application a long table such as used in factories was fitted up with a number of machines with friction clutch drive for each machine off a shaft underneath the table. All kinds of fan motors were shown. A 4.25-kw generator direct-connected to an American blower engine was the central feature of the exhibit.

THE DUNCAN ELECTRIC MANUFACTURING COMPANY, of La Fayette, exhibited a full line of its meters for direct and alternating current, the designs for direct and alternating current being very similar, both being commutator type meters. In this exhibit was also the La Fayette Electric Manufacturing Company's exhibit of Hornberger transformers. A new feature which is being put on meters when requested by a central station company is a dial reading in dollars and cents instead of kilowatt-hours.

ROTH BROTHERS & Co. exhibited their new style motor in ½-hp size driving a small job printing press with the Roth starting arrangement whereby the pressman controls the motor with a foot treadle. One of the neatest things about the exhibit was a line of blacksmith forge blowers consisting of a centrifugal fan blower with the motor completely enclosed in a casing of very neat form, which was continuous with the casing of the blower, thus keeping out dust and protecting the motor. Current for driving all the motors in the exhibit was furnished through a motor-generator set receiving 220 volts direct current and delivering 110. A number of grinding and polishing motors were shown. The largest was a big 5-hp emery grinder with the motor enclosed in a case ribbed to give maximum cooling.

EXHIBIT OF WESTINGHOUSE COMPANY.

THE ELECTRICAL SHOW management sends out the following announcement: "The Third Annual Electrical Show will be held in the Coliseum, Chicago, Jan. 13 to 25, 1908. A new departure has been determined upon in the matter of providing and installing all booth and electrical work for exhibitors by the Exposition Company, thereby saving our exhibitors a great deal of time, trouble and expense. The Electrical Trades Exposition Company proposes to include in the price for space all the following items: Booth, railing, floor covering, sign, furniture, wiring for one lamp for each 20 square feet of floor space, connection to mains, inspection fees, lamps, electricity for above lamps, janitor service, labor for placing exhibits on space and unpacking of same. Any railings, decorations or signs owned by exhibitors will be erected by the Exposition Company free, if in accordance with the rules and regulations of the company. Any additional wiring for electric signs or other electrical apparatus or devices will be done by the Exposition Company at actual first cost." Homer E. Niesz, managing director, can be reached at the Chicago Edison Company offices.

W. H. Schott, of Chicago, consulting and contracting engineer for central station heating plants and his representatives entertained visitors in one of the most handsomely appointed booths in the building.

The Sangamo Electric Company had a board on which was shown the construction and operation of its meters. These points were explained by F. J. Alderson, of that company, who was constantly in attendance.

The National Carbon Company had the booth made up with carbon columns, railings, and cornice, which has been a familiar feature at a number of previous exhibitions. It exhibited all kinds of carbon products and batteries.

Frank B. Cook had a large exhibit of telephone protective apparatus and construction material. Besides the telephone apparatus, the Cook wire joint, the universal guy clamp, and a land anchor wire of interest to all electric light, power and railway companies were exhibited.

The D. & W. Fuse Company exhibited a number of the latest things in the enclosed fuse line. One of these was the indicating plug cartridge fuse for use in Edison plug cut-outs. Another was a 60-ampere primary fuse box for use on 2,300-volt alternating circuits.

The Central Electric Company had some interesting samples of Knowles high tension insulators for which it is agent. Okonite wires, Columbia, Gem and tantalum lamps, deltabeston magnet wire and D. & W. enclosed fuses, were among the many other things for which this company is agent which were displayed.

The Holtzer-Cabot Electric Company made the Flexiphone one of the chief features of its exhibit. This is a flexible bracket for holding a telephone desk set which puts the telephone up out of the way when it is not in use. Waterproof bells and telephones for navy use were shown. The waterproof bell has no opening for a bell clapper but sounds the bell by means of a hammer in a flexible diaphragm. Small motors for various purposes were exhibited including a very neat polishing motor with handle for convenient carrying about.

The Simplex Electric Heating Company conducts a guessing contest with electric heating devices for prizes. The contest was to guess nearest the paid attendance at the show the five days from January 21 to 25. About 8,000 guesses were received showing the interest in the matter. The paid attendance for the five days was 46,163. The first prize, a 5-lb. Simplex flat iron, went to Miss Anna M. Kollertz. The second prize, a heating pad, went to Mrs. H. S. Ballinger. The third prize, a water heater, was taken by Mr. M. Buxbaum, and the fourth prize, a curling iron heater, went to Miss Rose H. Cunat.

The Gould Storage Battery Company had a handsomely appointed exhibit space in which were shown batteries for electric lighting service, railway station service, fire alarm, telephone exchange and telegraph office batteries. A large central station battery cell was shown with the Gould glass cover arrangement, which prevents spray from flying in the battery room. Samples of train lighting batteries put up in sets of two on rollers were shown. The company does a large business in this class of work. Exhibit boards showed the construction of the Gould automobile battery plates and central station battery plates. The Gould lead spinning process enables the use of a positive plate in its automobile batteries without sacrificing too much plate.

J. L. Schureman & Co., Chicago, exhibited a number of varieties of automatic motor starters. Two types of automatic pump starters were shown arranged to start the pump motor when the height of water in a tank or the pressure in a tank is decreased to a certain point, the motor being cut out when the water or pressure rises to another predetermined point. Several new types of elevator controllers have been recently developed. One of these is a new drum type of reversing switch with quick make-and-break and completely enclosed. It is intended for direct connection to the operating mechanism of an elevator. There was also a new system of full electrical control for elevators in which a set of mechanical switches actuated from a solenoid operated cam shaft replaces the magnet switches commonly used in such controllers. Magnet switches of from 25 to 1,000 amp. capacity for distant control of light and power circuits were also shown.

The Chicago Edison Company, occupying the largest and most prominent space in the building, designed its exhibit specially to attract the attention of home owners to the many applications of electricity in the home. Continual demonstrations were made of cooking, baking, washing, ironing, and sewing by electricity. In this exhibit was also a press room in which was printed the "Daily Electric City," which was distributed every day at the Show. A very pleasing method of illumination was used in this booth. Hollow beams of ground glass were placed across the ceiling at regular intervals. Inside of these beams were placed incandescent lamps. The light coming from such a large surface was beautifully diffused, while the ground glass kept down glare. A washing machine suitable for small families was shown in operation belted to a 1/20 hp electric motor. By throwing a lever, the motor can be disconnected from the rocking mechanism of the washing machine and caused to drive the wringer mounted on the edge of the machine.

The Chicago Pneumatic Tool Company exhibited a complete line of Duntley portable electric tools, including drills, grinders, blowers and hoists. The tools which were both of the alternating-current and direct-current type were all shown in operation. Drills of various sizes up to 3-in. capacity were shown. An interesting feature of the exhibit was a motor-driven portable hoist. Hoists of this type are made in sizes from 250 lbs. to one ton capacity and with lifts of from 15 to 25 ft. They are driven by Duntley two armature motors and are provided with dynamic brake and limit stops. The portable grinders and blowers driven by three-phase and single-phase motors of which several types and sizes were exhibited, were examined with much interest by visitors. Visitors especially interested in tools exhibited were presented with the company's catalogue No. 21, which has just been issued and which describes in detail the electrical devices manufactured by the concern. The company was represented at the show by C. B. Coates, C. A. Severin, C. W. Hayes and B. Rosenheim.

The H. W. Johns-Manville Company exhibited its other numerous electrical specialties including a line of "Victor" direct-reading instruments. These consist of "Victor" direct-current volt and ammeters, "Victor" combination meters, both switchboard and portable types, and a special "Victor" combination meter for automobile use. The "Victor" combination meter is, it is believed, the only direct reading electrical instruments of the kind on the market, giving a simultaneous reading of volts, amperes, watts and horse-power on one dial. It consists of a volt-meter and ammeter and is, therefore, practically two separate and complete instruments combined in one case so arranged that the indicators cross each other, each acting independently of the other, as far as volt and ampere readings are concerned. The readings in watts and horse-power are obtained from the point of intersection of the two indicators. Among the other materials exhibited should be mentioned the "J-M" friction tape. In this tape the friction is well worked into the fabric and runs true to gauge throughout the entire roll. "Noark" subway and service boxes were shown of one, two and three-pole construction and 250, 600 and 2,500-volt capacity. These are water-tight, being designed and tested to withstand a pressure of 25 pounds per square inch without leaking, and are, therefore, suitable for the most severe conditions. The company showed also a complete line of "Noark" national standard fuses, blocks and accessories and "J-M" overhead line material were shown. "Transite" controller linings were shown made of "Transite" asbestos fireproof lumber, an insulating material which absolutely prevents short-circuiting or grounding of the controller cover. "Transite" asbestos lumber was also shown in the form of fireproof doors, for high tension transformers and switches.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Low temperature and snow at many points stimulated retail demand for seasonable merchandise, but retarded movement of freight, which was beginning to show some improvement. In the Ohio Valley rains and floods have retarded demand and transportation and caused heavy damage, but the failure of the expected freeze to follow the floods is a good point for winter wheat. Collections were irregular and will probably continue so until roads become passable again. In the Southwest trade is good and the outlook for spring is excellent. Some Texas banks are loaning large sums of money in New York. On the Pacific Coast more favorable weather has helped building operations, but in the rest of the country there is somewhat less activity foreshadowed in building than a year ago. Large jobbers in dry goods at the East report better trade. In the Northwest heavy snows have checked wheat movement and coal trains have the right of way in that section, the result being beneficial to Western coal trade, but checking sales and collections, particularly in the Dakotas. Current weekly returns of gross railway earnings, although partial, show gains over the extremely good reports of last January, but net earnings are being whittled down by increased cost of operation following moderate gross receipts of preceding months. The week ruled strong and steady in pig iron markets at home and abroad. The advances in prices made by consumers to cover the higher prices for metal and other materials have had no effect against demands for all kinds of finished products. The inflow of business in the steel trades is enormous, more especially in finished products. Wire products are also in very large request. Rails are moving lively in light sections. The latest sales brought $33 to $34. In heavy rails the market is quiet, as most roads have closed for requirements a long time forward. Structural steel is beginning to reflect the high activity in the placing of contracts for summer and autumn constructional engineering. New business in copper was lighter, as consumers are covered for some time ahead. Quotations for future supplies range from about 24½ to 25¼c. per pound, the latter figure being for Lake. Prompt deliveries, however, would command higher prices. Among foreign and domestic consumers of large tonnages there is a confessed shortage of metal for March and April. Requests for anticipations are numerous. The general position of affairs among domestic producers is the refusal of business for later than May. Aluminum is quoted at 40 to 41c. per pound. *Bradstreet's* reports 252 failures in the United States during the week against 234 for the previous week, and 276 for the corresponding week of last year.

THE CROCKER-WHEELER COMPANY, of Ampere, N. J., has secured the following orders from some of its most important customers during the last few weeks. In many cases these are additions to existing electrical equipment which is composed principally of Crocker-Wheeler apparatus: Bridgeport Malleable Iron Company, Bridgeport, Conn., one 200-kw direct-current generator, 250 volts, 208 r.p.m.; one 90-kw, 208 r.p.m. direct-current generator. Pittsburg & Baltimore Coal Co., Edna Mine No. 2, Wendel, Pa., one 300-kw, direct-current generator, 575 volt., 150 r.p.m. W. & J. Knox Net & Twine Co., Baltimore, Md., twenty-five 25-hp direct-current motors, 230 volt, 750 r.p.m. Bridgeton Electric Co., Bridgeton, Conn., one 500-kw, direct-current generator, 550 volt, 120 r.p.m. Alliance Machine Co., Alliance, O., 74 motors ranging from 6 to 100 hp, all of 220 volts. Bosch's Troy Laundry, Austin, Tex., 14 motors ranging from ⅛ to 7½ hp, 115 volt, and one 35, 125 volt generator.

GENERAL ELECTRIC ENGINEERS.—The local office engineers of the General Electric Company from the principal cities in the United States gathered in annual session at the company's main office in Schenectady, N. Y., last week, January 21 to 26 inclusive. The synopsis of the discussions covered in detail the work during the year. Friday afternoon about forty of the engineers left the city in a special car for New York where they attended the first regular monthly meeting of the American Institute of Electrical Engineers in the new engineering building. Friday night the party continued on its way to Lynn, Mass., where the Lynn plant was inspected. Among the local office engineers in the New York-Lynn party were C. T. Mossman, of Boston; J. H. Lighthipe, of San Francisco; James Lyman, of Chicago; L. F. Demming, of Philadelphia; William H. Hand, of St. Louis; H. V. D. Allen, of Atlanta; W. S. Culver, of Cincinnati; W. G. Whitmore, of New York and L. Wilson, of Denver.

THE DETROIT INSULATED WIRE COMPANY, which has just entered the field, has a factory at Detroit equipped with the most improved and carefully selected devices for the manufacture of rubber covered wire. The departments turning out small conductors are already in operation, and the other departments for covering heavy wires and cables will be started as soon as the present congested condition among machinery manufacturers permits. The active management of the company's business is in the hands of Mr. J. H. Hunter, formerly of the National Cable & Wire Company, who is vice-president, and has charge of the manufacturing operations. The secretary and treasurer is Mr. Arthur Hartwell, formerly sales manager of the Westinghouse Electric & Manufacturing Company.

BELL TELEPHONE STATISTICS.—The following figures have been given out in Boston in anticipation of the annual report of the American Telephone & Telegraph Company:

	1906.	1905.	1904.	1903.
Instruments	7,107,836	5,698,258	4,480,564	3,779,517
Miles poles	154,035	145,535	136,547	130,178
Miles toll wire	1,436,236	1,265,236	1,121,228	975,702
Exchgs. and branch of	4,875	4,532	4,080	3,740
Miles wire on poles and buildings	2,783,167	2,183,167	1,654,379	1,358,140
Miles wire undergr'nd.	3,285,742	2,585,742	1,888,760	1,618,691
Miles submarine wire.	11,373	9,373	6,671	6,358
Total miles wire	6,080,282	4,778,282	3,549,810	2,983,189
Total circuits	1,407,900	1,335,449	930,251	798,901
Total emp.	90,000	74,718	59,451	53,795
Total stations	2,715,367	2,241,367	1,799,633	1,525,167

The stations have increased 239 per cent since 1900.

BOSTON ELEVATED CONTRACT.—The Boston Elevated Company has placed a contract with the Stone & Webster Engineering Corporation to make suitable additions or alterations to its present power stations sufficient to provide 12,000 additional horse power. The contract will call for an expenditure of between $1,000,000 and $1,200,000. The Boston Elevated has outgrown its power house capacity. At present the company is buying between 3,500 and 4,000 kw. from the Boston Edison Company. The work has been placed under the immediate supervision of Mr. F. N. Bushnell.

MAMMOTH WATER TURBINES.—The McCall Ferry Power Company has just contracted with the I. P. Morris Company, of Philadelphia, for six mammoth water turbines for its power plant on the Susquehanna River at McCall Ferry, Pa. These will be vertical shaft machines running at 94 r.p.m. under a head of 53 feet, and at ¾-gate opening will be capable of developing 13,500 hp each. Each turbine will have double runners. Delivery will begin late this year.

CATALOGUES WANTED.—Mr. Alberto H. Bernhard, 25 Avenue de la Gare, Menton, Alpes-Maritimes, France, who makes a specialty of American electrical material, especially novelties, would like to receive catalogues, literature and prices from American manufacturers seeking to do business in France. The current supply in his vicinity is 50 cycles alternating, 138-volt, single-phase for lighting, and 210-volt three-phase for power.

THE NEW YORK CENTRAL is rapidly pushing its electrification, and this week began to operate thirty trains on its Harlem Division with multiple unit-controlled electric cars between the Lexington Avenue temporary station at Grand Central Station and Wakefield. This is a step in the direction of relieving the situation at Grand Central Station.

CROCKER-WHEELER ANNUAL CONVENTION.—One of the facts that gave significance to the Crocker-Wheeler Officers' and Branch Managers' Annual Convention held January 23 to 26, was that during the year 1906 the company has done more business than in any other year since its foundation 18 years ago. As usual, the personnel of the company is almost exactly the same as it was at the previous annual convention. Just a year ago the selling men heard from Mr. Gano S. Dunn, the chief engineer and vice-president, the description of the new line of rolling mill motor, Form W, which was to revolutionize the electrical equipment of rolls, tables, etc., in mill practice. At this convention, reports were read by the various branch managers showing that especially in the Pittsburg territory the company has distinguished itself with this line of phenomenally strong and almost indestructible motors. The company's business in motors for machine tools and in alternating-current generators of large capacity up to 4,000 kw has continued to increase. Its line of Form L motors, 1/10 to 5 hp, is still reported as an unsurpassed machine within its range of horse power, although it has been on the market actively for three years. On Friday evening, January 25, the convention adjourned to the University Club at a dinner attended by 40 Crocker-Wheeler men. Those attending the convention and exercises were: J. R. Wilson, W. C. Appleton, H. B. Hussey, R. N. C. Barnes, C. W. Startsman, A. P. Olds, J. B. Milliken, H. C. Petty, G. H. Hall, H. Fuller, H. J. Sage, W. S. Watson, F. W. Kreps, S. Russell, Jr., H. M. Gassman, H. Lomas, J. M. Smith, M. E. Weissblatt, D. N. Force, Jr., Julian Roe, R. B. Treat, L. S. Horner, H. Pikler, C. N. Wheeler, H. A. Knoener, F. Young, A. Hartmann, B. A. Schroder, Rodman Gilder, R. J. Randolph, Jr., H. L. Patteson, A. L. Doremus (2nd vice-president), S. S. Wheeler (president), Gano S. Dunn (1st vice-president), W. L. Brownell (treasurer), F. B. DeGress and G. W. Bower.

COKE PRODUCTIONS.—The Bureau of the Census has just issued a bulletin on coke manufacture. This bulletin is a part of the census of manufactures for 1905, and was prepared by Dr. Charles E. Munroe under the supervision of Mr. William M. Steuart, chief statistician for manufactures. In 1905, 278 establishments, with a capital of $90,712,877, were engaged in making coke; and 29 coke establishments, with a capital of $2,703,149, were idle. From 1900 to 1905 the number of active establishments increased 15.4 per cent and the capital invested in such establishments increased 148.5 per cent. Over one-half of the capital was invested in ovens, the percentage being 55.4. The percentages for the other items of capital were 15.4 for buildings; 9.9 for cash and sundries; 9.7 for machinery, tools, and implements; and 9.6 for land. At the census of 1905, 1,386 salaried employees and 18,981 wage-earners were engaged in the work of the active establishments. Only 66 of these employees were children. The salaried officials were paid $1,247,502 and the wage-earners $9,304,498. The increases over 1900 for salaried employees and salaries were more than 50 per cent while the increase for wage-earners was only 11.7 per cent, although the wages increased 31.3 per cent.

BROOKLYN EXTENSIONS.—The Brooklyn Rapid Transit Company has announced that the size and capacity of its new Williamsburg power plant, at Kent and Division Avenues, are to be doubled. This will give the company the largest structure of the kind in the world, and should the other stations, scattered through the borough, break down, the boilers and turbines will be capable of generating 150,000 hp, or 30,000 hp more than is required to operate the entire Brooklyn Rapid Transit system in its heaviest rush hour. The final contracts for the new addition to the power house have been awarded and work will begin in a few days. The structure will be ten stories high. The cost is estimated at $5,500,000. In the half of the power station already constructed are four steam turbines, from which nearly 50,000 hp are generated. Four new turbines, each of 15,000 hp, the largest of the kind in the world, are being built in the Pittsburg shops of the Westinghouse Company for the new part of the station.

LARGE GARAGE FIRE.—More than 150 electric cabs—$320,000 worth it said—were destroyed on January 28 in a fire that started on the second floor of the building of the New York Transportation Company at Forty-ninth Street and Eighth Avenue, New York, and because of very poor water pressure was got under control only after two hours. The total loss is put at $600,000, but will probably be less. The company has the general electric cab service throughout the city and has about 700 vehicles. It carries an insurance of $400,000. The fire started in some oily waste in one of the repair shops.

EQUIPMENT WANTED.—Messrs. Barnum Brothers, Falls City, Ore., are in the market for machinery and supplies for a lighting plant; also for machinery for a 30-mile electric and steam standard gauge railway to be built as soon as quotations and material are supplied. The firm requests manufacturers and dealers to send catalogues, prices, etc.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was irregular throughout the week, but developed a weaker tone on the decision of the treasury to recall $30,000,000 of special government deposits from the banks in the near future. Governmental interference with the investigation of railroad matters, and the likelihood of further large issues of stocks, bonds and notes to provide money for improvements, also affected sentiment, tending to make railroad stocks less popular and to divert attention to industrials. Amalgamated Copper was decidedly strong and nearly recovered its 2 per cent dividend on Thursday. The traction stocks were also prominent, the Interborough issues showing weakness at first, but holding somewhat better after announcement of the change in the presidency. All of the electric and traction stocks made substantial advances compared with the previous week's business. The curb market reflected the same apathy which prevailed on the Exchange. Liquidation was the feature. The rise in British Columbia Copper appeared to have been manipulated by a pool for the purpose of making a market for the new stock. Following are the closing quotations of January 29 on the Stock Exchange:

NEW YORK

	Jan. 22	Jan 29		Jan, 22	Jan. 29
Allis-Chalmers Co.	15¾	14¾	General Electric	161¼	158
Allis-Chalmers Co. pfd.	40	37	Hudson River Tel	...	...
American Dist. Tel	...	...	Interborough Met. Com.	36¾	34¾
American Locomotive	73	71½	Interborough Met. pfd.	72⅜	71¾
American Locomotive pfd.	111	111	Mackay Cos.	73	...
American Tel. & Cable	83	83	Mackay Cos. pfd.	70⅝	...
American Tel & Tel.	...	...	Marconi Tel.	...	...
Brooklyn Rapid Transit	76⅜	73¾	Metropolitan St Ry.	...	...
Electric Boat	30	31	N. Y. & N. J. Tel.	...	...
Electric Boat pfd.	73	73	Western Union Tel.	83½	83
Electric Vehicle	...	...	Westinghouse com.	151¾	150
Electric Vehicle pfd	...	...	Westinghouse pfd.	...	...

BOSTON

	Jan 22	Jan. 29		Jan. 22	Jan. 29
American Tel & Tel.	128	128	Mass. Elec. Ry. pfd	68	69½
Cumberland Telephone	...	110¼	Mexican Telephone	4	...
Edison Elec. Illum.	...	227½	New England Telephone	122	120¾
General Electric	161½	...	Western Tel. & Tel.	...	8¾
Mass. Elec. Ry.	...	19⅛	Western Tel. & Tel. pfd.	79¼	78

PHILADELPHIA

	Jan. 22	Jan. 29		Jan. 22	Jan. 29
American Railways	50⅛	50¾	Phila. Electric	7¾	7⅞
Elec. Co. of America	10⅝	10⅛	Phila. Rapid Trans	22¾	21¾
Elec. Storage Battery	65	65	Phila. Traction	86	85
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Jan. 22	Jan. 29		Jan. 22	Jan. 29
Chicago City Ry.	160	150	National Carbon	80	80
Chicago Edison	...	140	National Carbon pfd.	117	117
Chicago Subway	40	38	Union Traction	...	...
Chicago Tel. Co.	...	..	Union Traction pfd.	...	...
Metropolitan Elev com.	27	28⅛			

*Ex-dividend

BRITISH WESTINGHOUSE.—The British Westinghouse Electric and Manufacturing Company has issued a circular in connection with the reduction in the company's capital stock. It says, in part: "The directors recommended a reduction in the capital of £1,375,000. Of this amount it is proposed to devote the sum of £1,038,816 13s 6d to the writing down of patents and good will, works and equipment, material and stock in hand, etc., and to the provision of an adequate reserve in respect of developments, contracts, and work in progress undertaken in previous years. It is proposed to devote the balance of £291,193 6s 6d to the extinction of the suspense account. To meet the above reductions in the capital assets of the company the directors recommended that the share capital be reduced by writing off £2 per share from the 500,000 preference shares and £5 per share from the 75,000 ordinary shares. At the same time the directors recommended that the rate of dividend should be increased as follows: On the preference shares from 6 per cent to 10 per cent and on the ordinary shares from 6 per cent to 12 per cent, the division of any surplus profits between the two classes of shareholders remaining as at present—

namely, one-fourth thereof among the preference and three-fourths among the ordinary shares." The annual report states that during the early part of the year which ended on July 31 the contracts carried over from the previous year and certain other contracts resulted in a considerable loss. Since January there has been almost a complete change in the methods and management of the company. Manufacturing costs have been decreased and the efficiency of the general organization improved. Since the close of the financial year the orders taken show a large increase over those of the corresponding period of last year, and the trading results appear to warrant the conclusion that the business of the company has reached a turning point.

TELEPHONE MERGER.—Indications are pretty definite as to another Bell-Independent telephone consolidation. The Rochester, N. Y. *Herald*, of January 25, says: "Negotiations are under way for a union of the interests of the American Bell Telephone Company with those of the United States Independent Telephone Company. If a proposition to be submitted to the stockholders and bondholders of the United States Independent Telephone Company is accepted, the holdings of the company will probably pass under a control which, if not identified with that of the American Bell Telephone Company, will be in harmony with it, and a gigantic merger will be effected of the interests and operations of both concerns. During the last two weeks the principal stockholders of the United States Independent Telephone Company, with the exception of Thomas W. Finucane, have been in touch with the Bell capitalists in New York city, and negotiations have reached a point which enables them to make a definite and final proposition to the company's stockholders. Precise terms of the understanding between the controlling capitalists of the United States Independent Telephone Company and the Bell people have not yet been made public, nor has the plan for taking over the stocks and bonds of the company been formulated. It is rumored, however, that the bonds of the U. S. I. T. Company will be made good on a 4 per cent basis, and that a price will be offered for the stock considerably above the present market quotation, which yesterday was 3½ for the stock and 19½ for the bonds. The stock was originally put on the market at 50 and the bonds at 80."

MACKAY TELEPHONE INTERESTS.—It has been well known that the Mackay telegraph interests had considerable holdings in Bell Telephone. A statement filed with the Stock Exchange authorities is the first public compilation of the companies in which the Mackay Companies are interested. The amount of the holdings in the various companies is not given, but it is shown that, including the entire capital stock of the Commercial Cable Company and various Postal Telegraph companies, the holding company has stock in 102 cable, telegraph and telephone companies. Of the Bell subsidiaries the Mackay Companies has stock in the Buffalo, Canada, Missouri and Philadelphia Bell companies, the Cumberland Telephone and Telegraph, the Hudson River, Michigan State, Missouri and Kansas, Nebraska, New England Telephone and Telegraph, New York and New Jersey, Pacific States, Pennsylvania, Pioneer Telephone and Telegraph, Rocky Mountain Bell, Southern New England, Tri-State Telephone and Telegraph and Western Telephone and Telegraph. Of the cable and foreign telegraph companies in the list these are the more notable: Commercial Pacific, Commercial of Cuba, Direct West Indies, Direct United States, Great Northern of Copenhagen, Halifax and Bermuda, Deutsch Atlantische Telegraphen Gesellschaft, Mexican Telegraph, Montreal Telegraph and Western Telegraph Company of London. The company has holdings, among others, in the American District Telegraph companies of New Jersey and Philadelphia and the Boston District Messenger Company.

HEAVY TAX PAYMENTS.—The Interborough Rapid Transit Company has paid up the franchise tax arrears of the Manhattan Elevated Railroad in full, sending to the Finance Department checks for $3,170,141.71. This covers all assessments under special franchises and the franchise tax law from 1900 up to the beginning of 1906, and constitutes the largest payment made under the law. The taxes for last year will not be in arrears until July. The taxes paid had been contested as illegal or excessive. Attorney General Jackson, in co-operation with Corporation Counsel Ellison of New York City, is planning an active campaign to collect arrears of taxes on special franchises from nearly all the public utility corporations in New York, many of whom have paid none since the franchise tax measure became a law. The attorney general has given out a list of proceedings in which no referee has as yet been named, and where for that reason there need be no delay. The attorney general said that he would in a couple of days appoint referees to hear these proceedings. The list follows in part: Commercial Cable and Telegraph Company, 1900 to 1906. Western Union Telegraph Company, 1900 to 1906. John B. McDonald, 1902, 1903, 1904. Automatic Fire Alarm Company, 1905. Tubular Despatch Company, 1906. Williamsburg Terminal Railway Company, 1906. Brooklyn Union Gas Company, 1906. Manhattan Railway Company, 1906.

GENERAL ELECTRIC EARNINGS.—The earnings of the General Electric Co. for the fiscal year ending January 31, 1907, according to high authority, will run close to $10,800,000, thus establishing a new high record. The earnings of the company in the current quarter show a very large increase over the preceding quarter and new business has been coming in at the rate of $1,500,000 a week. The General Electric Co. is beginning to receive benefits resulting from the higher prices for its products. This, together with the fact that it has purchased no copper as yet above 20 cents a pound, has materially strengthened the company's position from the standpoint of income. Earnings of $10,800,000 mean nearly 20 per cent on the stock for the current fiscal year, based on its capitalization of $54,306,200 reported on January 31, 1906, compared with earnings of $7,319,000 in the preceding year, or a little over 15 per cent on the capitalization of $48,247,000 reported January 31, 1905. The General Electric Co. will close its fiscal year ending this month with a surplus of nearly $17,500,000, as compared with $12,027,295 on January 31, 1906. If the sum of $1,000,000 is written off for patent account as was the case last year, the General Electric will show a final surplus for the fiscal year 1907 of approximately $5,500,000.

DIVIDENDS.—Directors of the Twin City Rapid Transit Co. have declared the regular quarterly dividend of 1¼ per cent on the common stock, payable February 15. The board of directors of the Lawrence Gas Co. has declared a semi-annual dividend of 4 per cent, payable to stock of record January 25. This is an increase in the anual rate of 2 per cent. Directors of the Coney Island & Brooklyn Railroad Co. have declared the regular quarterly dividend of 2 per cent on the capital stock payable February 1. Books close January 26 and reopen February 2. The American Graphophone Company has declared the regular quarterly dividend of 1¾ per cent. Directors of the National Carbon Co. have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable February 15. The directors of the Philadelphia Company have declared the regular semi-annual dividend of 2½ per cent on the preferred stock payable March 1. Directors of the North American Co. have declared the regular quarterly dividend of 1¼ per cent, payable March 1. Directors of the Boston Elevated Co. have declared a regular semi-annual dividend of 3 per cent, payable February 15.

NORTHERN OHIO REPORT.—The Northern Ohio Traction & Light Company has issued its annual report for the year ended December 31, 1906. The income account compares as follows for the combined properties:

	1906.	1905.	Changes.
Gross	$1,703,340	$1,552,970	Inc. $150,370
Expenses	1,006,842	898,830	Inc. 108,012
Net	$696,498	$654,140	Inc. $42,358
Charges	483,173	471,503	Inc. 11,670
Surplus	$213,325	$182,637	Inc. $30.668

The total gross revenue from the railway for the year 1906 amounted to $1,577,090, against $1,431,057 for the year 1905, an increase of $146,033 or 10.2 per cent. The average earnings per mile of track, all divisions, were $7,885, against $7,209 in 1905. The total gross revenue from lighting for 1906 was $126,249, against $121,912 in 1905, an increase of $4,337 or 3.55 per cent.

CINCINNATI BELL TELEPHONE.—The directors of the Cincinnati & Suburban Bell Telephone Company have voted to increase the capital stock from $5,000,000 to $8,000,000 and the stockholders will be asked at the annual meeting on February 20 to approve their action. The company now has but $22,000 unissued stock in the treasury. The new stock will be sold to stockholders at par in the ratio of one share of new stock to every ten shares of the old stock held at present.

NORTH AMERICAN EARNINGS.—The financial statement of the North American Company for 1906 as read at the annual meeting shows net earnings for the fiscal year ended December 31, of $2,674,620. Of that sum $103,223 represents interest received and accrued, and $923,906 dividends received. In addition to these earnings the company's share in the undivided earnings of its constituent companies for the year was $982,344, equivalent to 3.29 per cent on the outstanding stock of the holding company. Besides the income from dividends and interest the company received $25,261 as compensation for services, and the increase in the value of assets as readjusted December 31 was $1,721,500. Dividends of $1,487,305 were paid, and the balance on December 31 was $3,999,548, against a balance of $2,812,232 on December 31, 1905. As the company's outstanding capital stock was increased during 1905 from $17,000,000 to $29,635,500 and during 1906 from the latter figure to $29,791,300, the percentage shown as being earned in 1905 and 1904 would be somewhat less on the present basis of outstanding stock. The increase in the value of its assets during the year is placed by the company at $1,721,500 and the amount included in the income account. Had this sum not been included in the income account the amount available for dividends for the year would have been but $953,122, equal to 3.19 per cent on the outstanding stock. During the year ended December 31, 1905, the company placed the increase in the value of assets at $920,000, and in the previous year at $701,119. Its equity in the undivided earnings of its constituent companies for 1906 is figured by the North American Co. at $982,345, equal to 3.29 per cent on its outstanding stock.

WASHINGTON WATER POWER.—The capital stock of the Washington Water Power Company, Spokane, Wash., is to be increased to $10,000,000—doubling the present capitalization of the corporation. It is officially announced that a meeting of the stockholders of the company is to be held March 4 for the purpose of confirming the action of the board of directors in reference to the increase of the capital stock. Apparently no doubt exists that the plan to increase the stock of the company will be approved by the stockholders. "The money to be derived from the new stock to be issued will be used in betterments and improvements," stated Secretary H. L. Bleecker. "It is not proposed to issue all the new stock at once, but it will probably be issued from time to time as new capital is needed for the purposes for which the stock is increased. It is probable that the first stock to be issued will amount to 20 per cent of the increase, or $1,000,000. Additional issues of a like amount will probably be made from time to time until all the stock is taken. The present stockholders of the company will have the first privilege of purchase and may be expected to avail themselves of it in nearly every instance, as they have done in the past." The present stock of the Washington Water Power Company is divided into 50,000 shares of the par value of $100 each. The meeting March 4 will authorize an issue of 50,000 additional shares, making 100,000 shares of the par value of $100 each. The company only about four years ago had a capitalization of but $2,000,000. This was increased to $3,600,000 and later to $5,000,000.

TOLEDO RAILWAYS & LIGHT.—The annual report of the Toledo Railways & Light Co. for the year ended December 31, 1906, shows smaller percentage increases in gross and net earnings and in surplus than did the report for the previous year. It also shows a larger percentage increase in operating expenses and a larger percentage ratio of operating expenses to gross earnings than in 1905. During the year the company maintained the efficiency of its system and carried through a number of improvements, and the less favorable showing of a portion of its income account may be partly due to this. The percentage increase in gross earnings, however, was smaller, with the exception of that of the year 1904, than of any year since 1898. In the report mention of the fact is made that last October the company entered into a contract with the city of Toledo for lighting all public thoroughfares and public places for a period of ten years from Jan. 1, 1907. As a result of this contract the company has discontinued all free light and power, which under the previous contract amounted to about $7,000 per year. The company expects large returns from its electric lighting and power business in the years to come. The report shows gross earnings of $2,047,611, an increase of $134,155 over those of a year ago. Operating expenses increased from $972,994 to $1,071,773 and net earnings from $940,462 to $975,838. The surplus on Dec. 31 was $466,231, against $430,155 on the same date in 1905.

KEYSTONE TELEPHONE.—The following is the profit and loss account of the Keystone Telephone Company, Philadelphia, the Keystone Telephone Company of New Jersey, the Keystone State Telephone and Telegraph Company and the Eastern Telephone and Telegraph Company (for the last quarter of the year only) for year ending June 30, 1906:

Gross earnings		$830,049.05
Operating and maintenance charges, including taxes and provisions for doubtful debts		458,954.77
Balance available for interest and reserve, etc.		$371,098.28
Reserves for renewals	$79,642.53	
Interest charges	214,233.38	293,875.91
Net profit for the year		$77,218.37
Surplus account for June 30, 1905		342,083.16
Surplus June 30, 1906		$419,301.53

The Keystone Telephone underground conduit system, located in 278 miles of street, with a capacity of 11,648,439 duct feet, is installed with 1,926,419 feet of cable. Over a large part of the system the conduit capacity exceeds the company's requirements, making the unused portion available for electric enterprise of almost any character. The switchboard capacity of the plant is 16,800 lines, of which 11,989 lines have been installed, with 20,888 telephones in use.

WASHINGTON TELEPHONES.—The anual report of the Chesapeake and Potomac Telephone Company for the past calendar year has been placed before Congress. The receipts have been $1,011,119.73, of which $956,574.73 were telephone earnings and $54.545 real estate earnings. The expenditures of the company were as follows: General administrative and taxes, $100,244.04; traffic expense (central office operating, pay station commissions, directories, advertising, canvassing and collecting), $228,089.69; maintenance, current repairs, renewals and replacements, $293,609.70; rentals and sundries, instrument rentals and roof rents, insurance and damage and compensation, $51,124.24; real estate expenses (care and operation of buildings), $59,274; interest charges, $127,890; total expenditures, $860,231.67. Net earnings, all sources, $150,888.06; depreciation, $101,648.30; revenue balance, $49,239.76. The report relates that the proceeds of company's notes have been $645,016.69. The company has expended for underground conduits and cables, $281,514.51; for poles, aerial wires and fixtures, $84,331.98; central office equipment, station apparatus, furniture and fixtures, $279,170.20; being a total of $645,016.69. The cost of work of the telephone company (not including real estate) in the District of Columbia is $3,325,358.63.

DISTRICT TELEGRAPH.—The American District Telegraph Company shows for the year ending December 31, 1906, a gross of $603,643, net of $85,920, and a surplus over dividends of $9,032. It has a total surplus of $115,683, 1,587 miles of wire, 86 offices and 33,131 instruments. President Clowry says: "Of the $3,844,700 capital stock outstanding, $5,500 belongs to and is in the company's treasury." The number of messages delivered during the year aggregated 5,461,944 and messages collected 2,789,105. "While dull periods in Wall Street were reflected in the earnings, the business of the company averaged well for the year, as is shown by the advance of $9,948 over the increase of $32,632 of the previous year. I regret to say, however, that an increase in the compensation of messengers, necessitated by prevailing local labor conditions, caused an increase of over $25,000 in the messenger expense. This increase is in part reflected in the increase of $19,402 in the total expense. The cost of wiring new buildings, installing additional call-boxes, etc., was $12,793, and as usual was paid out of earnings, and the amount is included in the expenses for the year."

ELECTRICAL EARNINGS.—The following properties under Stone & Webster management report the following figures for Novmber: Cape Breton Electric Co., Ltd., gross earnings, $22,861.08; twelve months, $256,409.19; balance, $51,016.48. Houghton County, Mich., Electric Light Company, gross, $26,103.12; twelve months, $234,680.61; balance, $85,791.76; Lowell, Mass., Electric Light Corporation, gross, $28,334.29; twelve months, $276,793.97; balance, $88,204.94; Edison Elec. Ill. of Brockton, Mass., gross, $17,814.21; twelve months, $165,848,65; balance, $44,900.04; Minneapolis General Electric Co., gross, $79,044.62; twelve months, $796,525.72; balance, $253,242.11. All show healthy progress over last year.

GENERAL NEWS.

Construction News.

GADSDEN, ALA.—The Coosa River Electric Company has changed its original plans and new plans have been approved by the war department at Washington. R. H. Cobb is president.

HUNTSVILLE, ALA.—The City Council has instructed the light committee to investigate and report on the advisabilty of the city establishing and maintaining a municipal electric light plant.

BISBEE, ARIZ.—The Bisbee Improvement Company is taking steps to remodel its electric light plant, and has engaged Louis R. Fosdick, of New York, N. Y., to prepare the plans and specifications.

PRESCOTT, ARIZ.—The City Council has granted an electric lighting franchise to M. J. Hickey, Geo. C. Ruffner and Ray Hill.

CHICO, CAL.—The Chico Gas & Electric Company will, during the next two months, completely overhaul its power and lighting service and rewire the city. The street lighting system will be changed from the series to the multiple arc and additional transformers installed.

LOS ANGELES, CAL.—Five new electrical franchises will be sold by the supervisors on Feb. 18. Four of these are asked for by the Los Angeles-Pacific railroad for its proposed subway projects. The other will be sold at the request of Robert Marsh & Company for a line on Pico Street.

MOUNTAIN VIEW, CAL.—To improve the service at Mountain View and Sunnyvale, the United Gas & Electric Company is erecting a new sub-station at Mountain View.

OROVILLE, CAL.—The Indiana Gold Dredging Company is preparing to install a power plant to operate its apparatus by electricity. M. A. Eckart will have charge of the work.

OROVILLE, CAL.—E. J. Mitchell, city clerk, writes that the City Council may call an election to vote on issuing bonds for a gas plant, and possibly an electric light plant.

OROVILLE, CAL.—Engineer L. J. Hohl, who was engaged by the City Board of Trustees to render an estimate for furnishing this city with a municipal water, electric light and gas system, has filed his report, which has been accepted by the Board. In regard to an electric light plant, it was his opinion that it would be cheaper to purchase electricity from the power companies than to erect a plant.

OROVILLE, CAL.—A. R. Bidwell, superintendent of the Great Western Power Company's operations in Plumas County, California, has taken charge of the work at that point. The principal operations of the Great Western Power Company at present are centered at Big Bend, Butte County, where it is planned to erect a plant with a capacity of 50,000 hp which will require two years to complete. The company proposes to enlarge the Big Bend tunnel, erect an extension whereby the water can be diverted into the main channel below Island Bar, and thus secure a fall of 500 feet. This work is in charge of C. H. Hollingsworth, and the consulting engineer is M. A. Viele, of the engineering firm of Cooper, Viele & Blackwell, of New York. The company will also construct reservoirs to furnish water for power plants that may be established between the above plants and Oroville.

RIO VISTA, CAL.—The Rio Vista light and power plant was recently destroyed by fire, entailing a loss of $10,000.

SACRAMENTO, CAL.—The Western Pacific Railway Company will install an electric plant at Flower Lake tunnel and use electricity to run the drills and light the tunnel which is now under construction.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph Company, which succeeds the Pacific States Telephone & Telegraph Company and the Sunset Telephone Company by merger, has completed its organization at a meeting held recently in Martinez, by electing the following officers: Henry T. Scott, president; Louis Glass, vice-president; E. J. Zimmer, second vice-president; T. E. Sherwin, auditor, and F. W. Eaton, secretary and treasurer. The office of general manager was abolished. The headquarters of the company will be in Portland, Ore.

GREELEY, COL.—The Central Power Company is considering the construction of a water power plant on Poudre River, in Zimmerman's Valley, about 75 miles from Fort Collins. D. H. Moffet, of Denver, is president.

GREELEY, COL.—The Northern Colorado Power Company, of which W. J. Barker is president, has placed orders for $25,000 worth of material for the street lighting system.

STEAMBOAT SPRINGS, COL.—The Steamboat Springs Electric Company will place orders within 60 days for a new and complete generating station of 150 hp, including generator, engine, boilers, switchboard and all accessories. D. L. Carver is superintendent.

BRISTOL, CONN.—The Bristol Manufacturing Company has completed plans for an extensive power plant to be erected on Riverside Avenue.

CANAAN, CONN.—The contract has been signed between the village of Millerton and the Berkshire Power Company for electricity to light the streets of the village of Millerton. The contract is to run five years.

DANBURY, CONN.—F. B. French is contemplating the installation of a lighting plant in his store. Mr. French has not yet decided whether he will install a gas or electric plant, but whichever is decided upon a plant of sufficient size to light the whole block will be installed.

HARTFORD, CONN.—The New York, New Haven & Hartford Railroad Company is making substantial progress in electrifying its steam tracks in Central Connecticut. The electric service between Middletown, Berlin and Meriden will be established in May. Electricity for operating the line will be supplied from the power plant at Berlin. The electrification of the Highland Division tracks for the interurban electric service between Hartford, Rockville and Melrose will probably be completed in March. Electric power for the line will be furnished by the Hartford Electric Light Company, which is now constructing a sub-station at Burnside.

JEWETT CITY, CONN.—At a meeting of the electric light commissioners held recently it was decided to increase the price of electricity for lighting purposes 25 per cent. It was also decided to install a meter in the power house to record the electric energy consumed by the borough, as the borough is now to be charged meter rates for street lighting. Heretofore the borough has paid $1,500 for lighting the streets and much of the time has been without light. The new rate dates from Jan. 1 and will be 10 cents per kw-hour.

MYSTIC, CONN.—It is stated that the Mystic Electric & Gas Light Company is contemplating obtaining electricity for operating the local system from the power house in Westerly.

NEW BRITAIN, CONN.—It is reported that the Consolidated Railway Company has sold out its New Britain Lighting plant to the Hartford Electric Light Company. The negotiations provide for the sale of the plant on Chestnut Street, which was abandoned by the Connecticut Railway & Lighting Company when it arranged for securing power from Bulls Bridge. Under the new regime it is stated that the Chestnut Street plant will again be pressed into service.

WESTFIELD, CONN.—The Pope Manufacturing Company is installing a new generator of 560-kw capacity in its plant to take the place of one of smaller capacity.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Feb. 12, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va., and Charleston, S. C., a quantity of naval supplies, as follows: Schedule 376—Spare parts for wireless telegraph systems, wire, insulating clips, electrical supplies, electric hoists, etc. Schedule 380—Electric wire, etc. Applications for proposals should designate the schedule desired by number. E. B. Rogers, Paymaster-General, U. S. N.

AMERICUS, GA.—The City Council has accepted the proposition submitted by Wm. A. Dodson and associates, including LeRoy Davidson & Company, and several Philadelphia capitalists, for electric franchises in Americus. About $200,000 will be expended in the installation of electric power plant of sufficient capacity to light the city, pump the water supply into mains and operate an electric railway. A 4-mile electric railway will be constructed and a pleasure park laid out.

FORT McPHERSON, GA.—Bids will be received until Feb. 20 for furnishing and installing electric light fixtures in post exchange and gymnasium buildings at this post by Capt. B. B. Buck, constructing quartermaster.

NEWNAN, GA.—H. B. Pringle, secretary water and light commission, writes that it is proposed to construct a new electric plant the coming summer, but no plans or specifications have been prepared as yet. S. W. Allen, superintendent of commission, will be engineer in charge.

SANDERSVILLE, GA.—The City Council has employed Arthur Pew, Atlanta, as consulting engineer for the proposed sewer work, to cost $20,000, and improvements to water works and electric light plant, to cost $10,000.

ALTON, ILL.—A meeting of business men was held recently to discuss a plan for starting an electric lighting plant in opposition to the one being operated by the Alton, Granite & St. Louis Traction Company. The plan of the promoters is to supply electricity for light and power to business houses and later to extend the service to residences.

COLLINSVILLE, ILL.—Dissatisfied with the present lighting system, the municipality of Collinsville is considering the purchase of the lighting plant, with the intention of conducting it as a public utility under city control. City Attorney R. Guy Kneedler has been instructed to draw up an ordinance for the purchase of the plant and its equipment.

DECATUR, ILL.—Plans are being made for changes and improvements to the lighting plant of the Decatur Railway & Light Company, which is controlled by the McKinley syndicate. L. E. Fischer is manager.

FREEPORT, ILL.—The stockholders of the Freeport Railway, Light & Power Company have decided to install a new plant at a cost of $35,000 for electric light and power service. A. J. Goddard is general manager.

MAPLE PARK, ILL.—The citizens have voted to issue bonds for the installation of an electric lighting system.

SPRINGFIELD, ILL.—Surveys have been completed for the proposed road of the Southeastern Traction Company from Pana to Springfield, a distance of 51 miles.

SPRINGFIELD, ILL.—Mr. Reynolds, of Rockford, has presented to the State Legislature a bill giving cities outside of Chicago power to sell surplus electricity from municipal plants, and to fix rates to be charged for gas and electricity. It is a copy of the law of this kind for Chicago passed in the last session.

STREATOR, ILL.—The McKinley syndicate is acquiring the rights of way for an electric railway between this city and Ottawa, Ill.

BLUFFTON, IND.—A contract for the construction of an electric railway between this city and Norwalk, Ohio, will be let this Spring. The surveys have been completed and most of the right-of-way secured. C. P. Godfrey, Ottawa, Ohio, has the matter in charge.

CONNERSVILLE, IND.—The City Council has granted a franchise to the Connersville Street Railway Company. R. Neil Burgess is vice-president.

CRAWFORDSVILLE, IND.—The Chicago & Western Indiana Traction company, which was organized and incorporated by Edward H. Barrows, of this city, has been reorganized by the American Engineering Company. The latter company will undertake to complete the road.

FT. WAYNE, IND.—The officials of the Ft. Wayne Telephone Company announces that the Auburn system, which it owns, will be entirely rebuilt in the Spring.

MOORES HILL, IND.—The directors of the Moores Hill Telephone Company announce that they will receive bids for the installation of a new exchange.

MUNCIE, IND.—The pumping station of the Heat, Light & Power Company in Mount Pleasant township has been destroyed by fire. H. C. Ziegler is president.

RUSHVILLE, IND.—The Rushville Co-operative Telephone Company is contemplating the erection of a new building in the spring and installing a $25,000 automatic switchboard.

SMITHLAND, IND.—At the recent annual meeting of the Smithland Telephone Company it was voted to install a new switchboard.

SOUTH BEND, IND.—The County Commissioners have decided to ask for new bids for the installation of an electric light plant at the new county asylum.

SALPUPA, I. T.—The City Council has granted a franchise to J. J. Jones for a street railway.

MARSHALLTOWN, IA.—The question of issuing a bonus to the Marshalltown Electric Street & Interurban Railway will be submitted to the voters. It is proposed to build a power plant, car barns and machine shop at Marshalltown.

NEWTON, IA.—The City Council has decided to expend about $15,000 in new equipment for the municipal electric light plant.

SIOUX CITY, IA.—T. F. Bayne, chairman lighting commission, reports that a municipal light plant could be established for $85,000.

SIOUX CITY, IA.—The Sioux City Telephone Company is planning extensive improvements and extensions to its system, to cost $75,000.

WATERLOO, IA.—The Waterloo, Cedar Falls & Northern Railway Company is contemplating an expenditure of about $300,000 in improvements to the local and interurban lines. The construction of a new power house and the installation of additional machinery are under consideration.

LAKIN, KAN.—A franchise has been granted to Charles Waterman and T. N. Thorpe for an electric light plant which is to be in operation within 12 months.

LAWRENCE, KAN.—Plans are being prepared for enlarging the power plant at the university.

BOWLING GREEN, KY.—Bids will probably be asked for in February by the Green River Hydro-Electric Company, of Bowling Green, for the construction and equipment of a hydro-electric plant. H. von Schon, of Detroit, Mich., is consulting engineer.

GLASGOW, KY.—A movement is on foot to build a new electric railway from Cicillian to Elizabethtown, a distance of 25 miles. G. J. Lampton, of Louisville, is interested in the project. The matter will be taken up by the Commercial Club.

LOUISVILLE, KY.—Plans are being prepared by H. von Schon, of Detroit, Mich., for two water power plants for the Kentucky River Hydro-Electric Company, of Louisville.

BRUNSWICK, ME.—Charles Sumner Cook, of Portland, has secured control of the Brunswick Electric Light & Power Company.

CONOWINGO, MD.—Another large dam is projected in the Susquehanna River, at Conowingo, about 20 miles below McCall's Ferry. The Susquehanna Power Company will erect the dam and will develop a plant having a capacity of 100,000 hp, on which work will begin in the near future.

BOSTON, MASS.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 16, for furnishing the necessary labor and material to complete two 750-kw steam turbo-generator units at the navy yard, Boston. H. H. Rosseau is chief of bureau.

CAMBRIDGE, MASS.—The Cambridge Electric Light Company has petitioned the gas and electric light commission for authority to issue $100,000 new stock for improvements to its plant.

FALL RIVER, MASS.—W. B. Badger, of this city, is installing a complete electrical equipment for operating the plant of the Fall River Bleachery. The Algonquin and American cloth printing plants are operated by electricity, and the new Lincoln mill now in course of construction will be operated entirely by electric motors.

HUNTINGTON, MASS.—The Western Massachusetts Street Railway Company is making surveys for the extension of its line from Huntington to Lee. R. D. Gillett, of Westfield, is president.

NEEDHAM, MASS.—The Edison Electric Illuminating Company, of Boston, is making efforts to get control of the Needham electric lighting plant, which is owned by the town. The company furnishes electricity for operating the plant. The present contract between the company and the town for the supplying of energy has two years to run. The company proposes to buy the wires, poles and plant for $6,000, agreeing to expend $10,000 in reconstruction and to light the streets for twenty years at a cost of $12 per lamp per year, an increase of $2, or the town to expend $10,000 in reconstruction and make a twenty-year contract at $8 per lamp per year. The question will be submitted to the voters in March.

NEW BEDFORD, MASS.—The New Bedford & Onset Street Railway Company will petition the Legislature for the right to furnish electricity for street lighting to Wareham, and also for commercial purposes in that town.

NORTHAMPTON, MASS.—The Massachusetts Light Company is making arrangements to secure power from a dam to be constructed at Indian Head.

QUINCY, MASS.—The Gas and Electric Light Commissioners have authorized the Quincy Electric Light & Power Company to issue $50,000 additional stock to take up its floating debt.

RUSSELL, MASS.—The citizens are considering an organization to advance the industrial development of the town and also either to bring together the present owner of the power plant and parties who would like to locate here or to form a power company to complete the present power plant.

BAY CITY, MICH.—The Midland Light & Power Company will make application for a franchise to establish an electric light plant.

ISHPEMING, MICH.—The property and plants of the Marquette County Gas Light & Traction Company has been sold to Granger Farwell, of Chicago, Ill., and it is said that about $60,000 will be expended for improvements.

NEGAUNEE, MICH.—The Cleveland Cliffs Iron Mining Company expects to improve several of its water powers located in this vicinity, and has asked H. F. Pearce, of Negaunee, to look over plans.

NEGAUNEE, MICH.—The Lake Superior Construction Company has secured the right of way for a new interurban railway from Negaunee to Marquette, a distance of 18 miles. The company will make appplication to the cities of Negaunee and Marquette for franchises in February. J. W. Barber is secretary.

PETOSKEY, MICH.—The engine in the municipal electric lighting plant was wrecked Jan. 16.

PONTIAC, MICH.—Attorney M. F. Mills, of this city, has been engaged by a number of Detroit men to prepare a franchise for a gas and commercial electric light plant in Pontiac.

MANKATO, MINN.—M. B. Haynes, of Mankato, is preparing plans for developing water power from Spring Lake.

MINNEAPOLIS, MINN.—The contract for lighting the streets by electricity has not been awarded, as the Council is endeavoring to obtain more favorable terms than $84 per lamp per year. The Minneapolis General Electric Company has been requested to light its lamps from day to day while the Council is seeking to secure lower rates.

NEW ULM, MINN.—The Nicollet County Telephone Company is making an effort to secure control of the Shelby County line, owned by A. A. Buck, of Henderson.

NORTH BRANCH, MINN.—A. H. Swenson, according to reports, will install an electric light plant.

ST. HILAIRE, MINN.—The Duluth Engineering Company, of Duluth, is preparing plans for an electric light plant.

THIEF RIVER FALLS, MINN.—The citizens are considering the question of increasing the capacity of the municipal electric lighting plant, at a cost of $20,000.

VICKSBURG, MISS.—A bill has passed the United States Senate granting Houston Brothers permission to build a street railroad along the National Cemetery road, from Vicksburg to Waltersville. The

Houston Brothers contemplate the construction of an electric line from Vicksburg to Waltersville, and then extending it to Redwood, about ten miles north of the city.

CHILLICOTHE, MO.—The citizens have voted to issue $100,000 bonds for constructing a combined water and electric light plant. Burns & McDonnell, of Kansas City, Mo., are the engineers.

JEFFERSON BARRACKS, MO.—A new electric light plant is contemplated for this post, to cost about $50,000.

ST. LOUIS, MO.—The St. Louis County Court on Jan. 24 granted a franchise to the Wagner Electric Manufacturing Company to erect poles and string wires and to lay pipes to supply water, gas, steam and compressed air in a limited territory in the county. Although this service could be extended to the public it is understood that the franchise is desired that the company may install these utilities between the buildings of its new plant in De Hodiamont.

SAVANNAH, MO.—C. E. Stevenson and William B. Limerick are interested in the proposed Nodaway Valley electric line, which proposes to construct an electric railway from St. Joseph to Tarkio by the way of this city.

WEST PLAINS, MO.—W. L. Bell, of Kansas City, has purchased the plant and system of the West Plains Telephone Company.

STERLING, NEB.—Plans are being made for the establishment of an electric plant in this place. Fred Buehler and J. Jerabek is interested in the enterprise.

TEKAMAH, NEB.—The holding of an election to vote on the issuing of $10,000 bonds to remodel the water plant and construct an electric light plant is under consideration.

RENO, NEV.—The electric light plant of the Reno Power, Light & Water Company was burned on Jan. 15, leaving the town temporarily in darkness.

ASBURY PARK, N. J.—In the annual report of the Ocean Grove Association, Bishop Fitzgerald recommends the construction of an electric railway in the camp-meeting city, to be owned by the association or operated under lease.

FORT HANCOCK, N. J.—Bids will be received here until Feb. 25 for furnishing metal and wood machines, electric motors, etc. Information can be had on application to Commanding Officer.

PARK RIDGE, N. J.—The municipal electric light plant at Park Ridge will be sold at public auction at the court house, in Hackensack, on Feb. 19. The borough will endeavor to secure an injunction to stop the sale of the plant, pending an appeal.

PHILLIPSBURG, N. J.—The Town Council has awarded the contract for street lighting to the Easton Gas & Electric Light Company for a period of five years, at $65 per arc lamp per year.

ALBANY, N. Y.—The United Message Company, of Albany, has acquired all the stock of the Exchange Construction Company, of Albany, coming into control of the Clinton Telephone Company, of Plattsburg, the Adirondack Home Telephone Company, of Malone; also the Mountain Home Telephone Company, of Saranac Lake, recently organized to develop Saranac Lake and vicinity. The Message Company recently bought control of the important properties of the Commercial Union Telephone Company, of Troy. The United Message Company is headed by Irving H. Griswold and Theodore M. Brush.

CANASTOTA, N. Y.—The Central New York Power Company is erecting a temporary structure in East Canal Street in which to install the machinery to be used in generating electricity for lighting the streets.

FLUSHING, L. I., N. Y.—Bids will be received until Feb. 4 by C. B. J. Snyder, superintendenet school buildings, New York City, for installing electric equipment in buildings of the Parental School, Flushing, Borough of Queens.

FRANKFORT, N. Y.—At a special election held Jan. 17 the citizens voted to authorize the electric lighting commission to contract with the Utica Gas & Electric Company for electricity to operate the municipal electric light system.

FULTON CHAIN, N. Y.—The Fulton Chain Electric Company has applied to the State Commission of Gas and Electricity for a certificate of authority to transact business and to issue $5,000 in stock.

NEW YORK, N. Y.—Plans have been filed for the construction of a two-story station at Sixty-fourth Street and Amsterdam Avenue for the New York Edison Company, to cost $60,000. Charles T. Hoppe is the architect.

NEW YORK, N. Y.—The officials of the Manhattan Transit Company, of which the Longacre Electric Light & Power Company is a subsidiary, and which is seeking entrance in the electric conduits under the streets, have announced that contracts have been placed for a 10,000-hp electric plant to be built on Forty-second Street, west of Tenth Avenue. The order for the generating apparatus which has been given to the Wilkinson Steam Turbine Company, of Birmingham, Ala., calls for the delivery of this part of the plant in four months, and work will be begun immediately on the building.

POUGHKEEPSIE, N. Y.—T. R. Beal, general manager Poughkeepsie Light, Heat & Power Company, writes that no improvements are in contemplation.

SCHENECTADY, N. Y.—The Schenectady Illuminating Company and the Mohawk Gas Company will within the next 18 months expend about $700,000 in improving and extending their systems. Hinsdale Parsons is president.

WATERTOWN, N. Y.—The Commission of Gas and Electricity has denied the application to consolidate the lighting interests in Watertown. A new corporation was formed to acquire and consolidate the Watertown Gas Light Company and the Watertown Electric Company and to obtain additional water power. It was proposed to capitalize these properties at $1,800,000. After examining the plants and conditions at Watertown decided it would be against the consumers of gas and electricity to allow a consolidation. The commission also decided that the capitalization as asked for was excessive and only $700,000 of the stock and bonds were conditionally consented to by the commission.

WEEDSPORT, N. Y.—D. S. Pindell, of Iron River, Mich., has been in the city negotiating for the purchase of the plant of the Weedsport Electric Light Company. Mr. Pindell contemplates enlarging the plant and supplying Jordan and Port Bryan with electricity for light and power.

RALEIGH, N. C.—The Consumers' Light & Power Company, with headquarters in this city and temporary plant near Sanford, N. C., has been granted a charter.

ADDYSTON, OHIO.—Bids will be received until Feb. 12 by W. T. Coleman, village clerk, for street lighting with about 60 lamps.

CINCINNATI, OHIO.—The Union Gas & Electric Company has awarded to the Jeffreys Manufacturing Company, of Dayton, the contract for the coal conveyors for the Plum Street station. The 6,000-hp turbine generator is being constructed by the General Electric Company The total cost of work will be about $400,000.

CLEVELAND, OHIO.—F. B. Morgan, who is promoting the Cleveland & Sharon Street Railway, stated that the company will own the bridges along the line. To provide for the extra expense the Eldenbel Construction Company, of New York, which will build the road, will increase its capital stock from $2,500,000 to $3,000,000. and the additional bonds will be taken by the London house that will furnish the finances for building the road. The company is seeking a fifty-year franchise through Trumbull county, Ohio. The work of construction will be started this spring. Part of the grading has already been finished. It is believed the road will be operating in six months.

COLUMBUS, OHIO.—Plans are now being prepared for the new substation of the Columbus Citizens' Telephone Company, which will be erected here at a cost of about $6,000.

EATON, OHIO.—An ordinance has been passed by the Council granting a franchise to the Eaton Electric Light, Power & Ice Manufacturing Company. The franchise is for a term of 25 years.

FREMONT, OHIO.—The City Council has granted a 25-year franchise to Col. Webb C. Hayes, John W. Worst and Frank Heim, to build and operate a belt line street railway in Fremont.

HAMILTON, OHIO.—The Board of Public Service on Jan. 24 authorized an appropriation of $180,000 for the improvement and enlargement of the electric light plant and water works. A. L. Duwelius, Cincinnati, will have charge of the electric work.

NEWARK, OHIO.—A franchise has been granted by the City Council to the Newark, Utica & Mt. Vernon Traction Company, to operate a street railway on Main Street.

NEWCOMERSTOWN, OHIO.—The Newcomerstown Light, Heat & Power Company has been incorporated, with a capital of $25,000, by Henry Hess, R. L. Shoemaker, and others.

SANDUSKY, OHIO.—The Sandusky Telephone Company has decided to expend $15,000 in improvements to its system. J. K. Johnston is general manager.

ENID, OKLA.—The City Council has granted a street railway franchise to C. H. Bosler, of Dayton, Ohio.

MARSHFIELD, ORE.—A franchise has been granted to the Coos Bay Gas & Electric Company to furnish light and power in the city of Marshfield for a term of 35 years. The company will soon commence to furnish a day service. The temporary power house at Porter has been put into operation to furnish electricity for lighting North Bend.

SALEM, ORE.—The General Electric Company is contemplating many improvements to its railway system in this city.

BROWNSVILLE, PA.—The power plant of the West Penn Railways Company, which is to furnish electricity for operating the proposed electric railway between Brownsville and Uniontown has been completed, and will furnish electrical energy to operate the coke plant of the Century Coke Company. Besides furnishing electricity for the Century Coke Company it will also furnish power for operating many of the plants in the lower Connellsville region. Nearly all the plants building in that region will be operated by electricity.

COLUMBIA, PA.—All of the rights of way for the proposed electric railway from Millersville to Columbia have been purchased, and efforts are now being made to effect an entrance into Columbia Borough by agreement with its Council.

McCALL FERRY, PA.—We are informed that work on the dam of the McCall Ferry Water Power Company has not been indefinitely suspended as was reported in our issue of Jan. 26. The construction is being pushed energetically, a temporary bridge across the river providing a means for the rapid prosecution of the work. Flood and ice have

not necessitated a discontinuance of work at any time, nor has the dam been injured in any way.

PENNSBURG, PA.—The Montgomery Traction Company is planning to build a branch from its road as far as Kulpsville and later extend it to Harleysville and Sunneytown, connecting with the electric lines to be built in Perkiomen Valley.

PENNSBURG, PA.—Henry J. Smith, borough clerk, writes that it is proposed to construct an electric light plant at a cost of $15,000. An engineer has not yet been selected.

PHILADELPHIA, PA.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., by H. H. Rousseau, chief of bureau, until Feb. 16, for furnishing and installing underground electric cables, navy yard, League Island, Pa., as per specification No. 1523. The estimated cost is placed at $14,000.

ROCK ISLAND, S. C.—Claiming that the franchise has been forfeited, the town council of Rock Hill, S. C., has ordered the sale of the plant of the Rock Hill Water, Light & Power Company on Feb. 18, The sale includes the franchise. The proceeds are to go to the light company, after expenses have been deducted.

HUMBOLDT, TENN.—The Board of Public Works has decided to install a new 150-hp boiler so as to increase the capacity of tha water and light plant.

KNOXVILLE, TENN.—The State Legislature has granted the Knoxville Power Company permission to build a dam across the Little Tennessee River, above Knoxville.

NASHVILLE, TENN.—The National Power Company, of this city, will develop the water power at Lock "A," Cumberland River, and will transmit the electric energy to Nashville. H. von Schon, of Detroit, Mich., is consulting engineer.

CASTLETON, VT.—The Rutland Railway, Light & Power Company has installed a large transformer to its sub-station in Castleton preparatory to lighting the village.

NORTH POWNAL, VT.—The North Pownall Manufacturing Company has recently installed a complete electric lighting plant in its works.

NORFOLK, VA.—The contract for the new power plant of the Norfolk & Portsmouth Traction Company has been let to Schofield & Co. The plant will represent an expenditure of about a million dollars and will supply electricity for light and power for the Jamestown Exposition, and for the increased traction needs of the occasion.

RICHMOND, VA.—Mayor McCarthy has signed the ordinance appropriating $5,000 to employ experts on electrolysis with reference to damages to gas and water mains, and also appropriating an additional $5,000 for the same purpose to be used by the committee on water and electricity.

CHEWELAH, WASH.—The Council is considering the question of constructing water works and an electric light plant.

CHESAW, WASH.—J. Shaw is interested in the construction of an electric light plant.

NORTH YAKIMA, WASH.—T. A. Noble, representing Frederick Elmendorf, of Spokane, has filed an application with the County Commissioners for a franchise for an electric railway over the county road.

SOUTH BEND, WASH.—The County Commissioners have granted a franchise to M. C. Welsh for the construction of an electric railway between South Bend and Raymond.

SPOKANE, WASH.—B. J. Weeks, general manager of the Pacific Traction Company announces that the company will spend $8,000,000 in Tacoma.

WALLA WALLA, WASH.—The Walla Walla Traction Company will commence work in the spring on its new lines and extensions. The Second Street line will be continued to the cemetery and a spur on the Chestnut Street and the Chase Avenue will go to the fair grounds.

WALLA WALLA, WASH.—The Northwestern Gas & Electric Light Company, which recently came into possession of plants at Walla Walla, Spokane, Baker City, Pendleton, Milton, Weston, The Dalles, Salem, Eugene and other places in Oregon and Washington finds that it has reached the limit of its capacity, and is now looking for another source of power. It is stated on good authority that the company has about decided upon making use of falls in the Deschutes River in Oregon to generate power for plants in both Western Oregon and Eastern Oregon and Washington. The company's plant on the South Fork of the Walla Walla River in Umatilla County, has been put out of business three times since May, 1906, by disastrous floods. This plant furnishes electric light and power for Walla Walla, Pendleton, Athena, Milton and Weston.

ROWLESBURG, W. VA.—The citizens have voted to construct an electric light plant at a cost of $12,000.

ELLSWORTH, WIS.—The Ellsworth Heat, Light & Power Company has commenced work on the construction of its dam on the Rush River, eight miles from the city, which will furnish electricity for operating its system in this city. The steam plant of the company will be kept in readiness for emergencies.

FOND DU LAC, WIS.—The work of surveying the line for the Milwaukee & Fox River Valley electric railway, which will connect this city with Cedarsburg, has been started, and it is planned to begin the construction of the road in the spring.

LA CROSSE, WIS.—The La Crosse Gas & Electric Company has filed an amendment to its charter increasing its capital stock from $600,000 to $900,000.

MILWAUKEE, WIS.—Resident Engineer H. S. Bowen has informed the Finance Committee that a municipal light plant furnishing electricity for 3,000 arc lamps and 10,000 incandescents, would cost $1,000,000.

READSVILLE, WIS.—This village will soon vote to issue $3,500 bonds for an electric light plant, to be constructed in connection with the new water works. W. C. Kirchoffer, of Madison, is the engineer.

WRIGHTSTOWN, WIS.—The Wrightstown Milling Company has made an application for a franchise to construct and operate an electric light system in this place.

MONTREAL, QUE.—The Montreal Light, Heat & Power Company is now installing a 2,000-hp steam turbo-generator set in its Queen Street power house. The company expects to have its Soulanges Canal development completed by early fall, which will add 15,000 hp to its present capacity.

TORONTO, ONT.—The Island Committee has decided to adopt Park Commissioner Chambers' recommendation to accept the offer of the electric light company to light Centre Island and to dispense with the civic plant there. The city plant last year maintained 38 lamps at a cost of $1,315, while the same number of lamps could have been secured from the company, giving 25 per cent more light and burning all night, instead of till midnight only, for $1,104. Mr. Chambers recommended that the company be asked to submit tender on a 50-light service.

CITY OF MEXICO, MEX.—A corporation headed by Enrique Creel was formed recently in this city for the purpose of taking over a large electric power and irrigation enterprise about 22 miles above Santa Rosalia, Chihuahua. The corporation is known as the Cia Agriola y de Fuerza Electrica del Conchos and has a capital stock of $10,000,000. The Banco Central of this city has undertaken to finance the project.

PACHUCA, MEX.—Th Compania Electrica Irrigadora of Pachuca, which has been supplying the city of Pachuca with electrical energy for lighting and power from its plant at Juando, is now constructing a new generating plant at Elba, and is also making additions to the Juando plant and its plant at Pachuca. The company has recently placed an order with the Westinghouse Electric & Manufacturing Company for the electrical equipment for the entire work. The new plant is to be equipped with four 2,000-hp generators, and two 150-hp exciters. The cost of the new machinery will be approximately about $1,000,000.

PACHUCA, MEX.—Arrangements are being made to double the capacity of the electrical equipment in the plant of the Compania de Cemento Portland at Pachuca.

Legal.

DAMAGES FOR MENTAL ANGUISH; TELEGRAPH COMPANY NOT LIABLE TO PARTY, WHOSE INTEREST IN TELEGRAM DOES NOT APPEAR FOR FAILURE TO DELIVER MESSAGE.—In the States where mental anguish damages are recoverable against a telegraph company for its failure to deliver a telegram the overwhelming weight of authority is to the effect that a party, who is not mentioned in a message or whose interest therein is not communicated to the company's agent, cannot recover substantial damages for mental anguish. This doctrine is nowhere more emphatically declared than in the decisions of the Supreme Court of Texas where the doctrine of mental anguish is supposed to have originated. Helms vs. Western Union Telegraph Company, Supreme Court of North Carolina.

TELEPHONE EMPLOYE HELD TO HAVE ASSUMED RISK INCIDENT TO OCCUPATION OF "TROUBLE MAN."—A "trouble man," in the employ of a telephone company, was sent out to ascertain the cause of the failure of a number of telephones to work properly. He proceeded to the cable pole in the vicinity of the service complained of and began to climb it. Upon laying hold of a guy wire attached to the pole he received a shock which threw him from the pole and caused his death. The accident resulted from the sagging of the drop lines (which were originally constructed so as to run over and across certain electric light lines carrying a current of high voltage) down upon the latter in such a manner as to charge the drop lines, and through them, by means of certain "bridle lines," the guy wire, with a high degree of voltage. The sagging appeared to have been due to a severe storm. The evidence showed that the cable pole, which the "trouble man" was in the act of climbing at the time of his death, was wrapped with wire which came in contact with a metal peanut stand at a point near the ground, so that the deceased, upon grasping the guy wire, formed a complete circuit. It was held that the facts stated disclosed no negligence on the part of the telephone company and that the company was, therefore, not liable in damages for the death of its employe. He knew that something was wrong at the time he set out upon this particular job and that danger was connected with the work. He was skilled in the line of his employment and knew that he could have protected himself by the usual precaution of wearing rubber gloves. It was held that the danger came clearly within those assumed by him when he entered upon the occupation of trouble finder and such assumption of risk was an additional bar to the right to recover damages. Bell Telephone Company vs. Detharding, United States Circuit Court of Appeals.

LIABILITY OF TELEGRAPH COMPANY FOR TRESPASS.—If a telegraph company desires to condemn land for its poles and wires a method of determining damages is prescribed by law. But if the com-

pany, without any authority of law, enters upon and appropriates land without condemnation and against the protest of the owner, the owner is entitled to at least nominal damages, if no special damages are shown. Postal Telegraph-Cable Company vs. Kuhnen, Supreme Court of Georgia.

RIGHT TO RESCIND SUBSCRIPTION TO STOCK IN CORPORATION ON GROUND OF FRAUD AFTER INSOLVENCY.—In an action by the receiver of an insolvent corporation to recover on a note given for a subscription to the corporate stock, it was held that the subscriber could not rescind his agreement to subscribe on the ground that he was fraudulently induced to take the stock by misrepresentation as to the condition of the company, where it appeared that others had acted on the faith of his subscription and had given credit to the company. In such event the receiver represents the creditors as well as the corporation and is not barred from collecting subscriptions by the fraud of the corporation. Marion Trust Company vs. Blish, Appellate Court of Indiana.

LIABILITY OF MUNICIPAL CORPORATION FOR NEGLIGENCE IN OPERATION OF ELECTRIC LIGHTING PLANT.—In an action against the city of Richmond, Ind., to recover damages for the death of one alleged to have been killed through the negligence of the city in the conduct of its lighting plant, the city defended on the ground that, in the operation of the plant, it was acting under the police power in the discharge of a governmental duty and that it was, therefore, not liable. It is a well established rule that municipal corporations are not responsible in damages for injuries resulting from their negligence while acting in a public or governmental capacity. It was held that the city, in carrying on the operation of a lighting system, was acting in its private or corporate capacity, wherein it is liable for its negligence in the same manner and to the same extent as an ordinary business corporation. City of Richmond vs. Lincoln, Supreme Court of Indiana.

DUTY TO WARN EMPLOYES OF DANGEROUS ELECTRIC CURRENT.—In an action against the Manhattan Railway Company to recover damages for injuries resulting from contact with feed wires which supplied the electric current to the third rail by means of which the road was operated, it appeared that the plaintiff was in the defendant's employ as an ironworker; that in drilling holes he made use of heavy tools and that one of these came in contact with the feed wires mentioned, thereby causing the injuries for which damages were sought. The evidence fairly established that there must have been a defect in the insulating material on the feed wires, either existing prior to the accident or caused at the moment thereof by abrasion from the heavy iron tools used by the plaintiff in the course of his work. The plaintiff was allowed a recovery and, in his opinion, Judge Clarke placed particular importance upon the duty of a master to warn his servant of the dangers attending his work. It has always been the law that an employe assumes the obvious risks of his employment. But it is only the obvious risk that is assumed. Latent, hidden dangers known to the employer and unknown to the employe, of which no information or warning has been given, are not assumed. As to these dangers the master is under a legal duty to properly instruct his servants. Carey vs. Manhattan Railway Company, Appellate Division, Supreme Court of New York.

EMPLOYER'S LIABILITY FOR DEATH OF SERVANT RESULTING FROM CONTACT WITH LIVE WIRE.—The defendant manufacturing company directed telephone wires to be strung between two of the factory buildings and an electrician in the employ of the defendant ordered his two helpers, also in the defendant's employ, to do the work. In performing the work, the helpers, who had little practical knowledge of electricity, threw the telephone wires over the electric light wires which supplied light to the factory and which carried dangerous currents of electricity so that the telephone wires hung down immediately over a passageway. Both of the helpers came in contact with the wires and received shocks which rendered them unconscious. A crowd of operatives immediately gathered and one of them by the name of Ring grasped the live wire presumably for the purpose of pushing it out of his way, although warnings were shouted to him, the shock which he received causing his death almost immediately. It appeared that Ring had left that part of the factory where he was employed and approached the scene of the accident in violation of one of the defendant's rules which required employes not to leave the place of their employment during working hours without the foreman's consent. It was also shown that there was no means of shutting off the current upon the factory premises and that as soon as word was received at the factory office that there had been an accident someone there telephoned to the power house of the electric lighting company to shut off the current. It was held that Ring was guilty of negligence which essentially contributed to cause his death and that, for that reason, his administrator was not entitled to recover damages. Kennedy vs. Scoville Manufacturing Company, Supreme Court of Errors of Connecticut.

AMERICAN TELEPHONE COMPANY RESTRAINED FROM HOLDING CONTROLLING INTEREST IN KELLOGG SUPPLY COMPANY.—In a bill in equity, filed against the American Telephone & Telegraph Company by a minority of the stockholders of the Kellogg Switchboard & Supply Company, it was alleged that the Kellogg Company, an Illinois corporation organized for the purpose of manufacturing and selling telephone and telegraph instruments of all kinds, had capital stock consisting of 5,000 shares of $100 each; that for the purpose of restraining competition the American Company, through one of its agents, purchased 3,783 shares of the stock of the Kellogg Company; and that it was the intention of the American Company to elect and maintain a board of directors which should act not in the real interests of the Kellogg Company, but in the interests of and subservient to the American Company to the end that the latter company should be freed from the competition of the Kellogg Company and independent exchanges. It was also alleged that the complainants believed it to be the intention of the American Company, by voting the stock which it had secured, to dissolve the Kellogg Company. The relief asked in the bill was that the American Company, or its agents, be restrained from selling the 3,783 shares in its control; that a meeting of the stockholders be convened under order of the court for the purpose of electing a new board of directors; that at such meeting the American Company be restrained from voting its stock; that the American Company and its agents be restrained from attempting to dissolve the Kellogg Company and that the sales by which the American Company obtained its stock be set aside. It was held that the American Company could not lawfully purchase a majority of the stock of the Kellogg Company, either in its own name or through its agents, for the purpose of controlling the latter company and preventing competition between such company and itself. It was held to be immaterial that the action of the American Company would not necessarily result in a complete monopoly. The tendency in that direction was regarded as sufficient to condemn the transaction as unlawful. The object of the American Company was also immaterial, for the rule is that a corporation cannot purchase stock in another corporation, either in its own name or in the name of others, unless such power is given it by its charter or is necessarily implied in the charter. This rule, however, is especially applicable where the stock is purchased with the object of controlling the company which issues the stock and putting the company out of business as a competitor. The question as to whether the complainants, the minority stockholders of the Kellogg Company, were proper parties to maintain the bill was presented, and it was held that every lawful owner of stock in a corporation has the right to insist that others, assuming to vote shares of stock which they do not have the legal right to vote, shall be restrained. The injunction asked for was accordingly granted. Dunbar vs. American Telephone & Telegraph Company, Supreme Court of Illinois.

Obituary.

DR. H. M. FIELD, the well-nown clergyman and author, brother and biographer of Cyrus Field, and known also by his book on the Atlantic cable, died at Stockbridge, Mass., last week. He was born April 3, 1822.

MR. E. H. SEARS.—The death is noted on Jan. 20, at Collinsville, Conn., of Mr. Edward Hale Sears, president of the Collins Company, from pneumonia, after a short illness. He was also president of the Farmington River Power Company at the time of his death. He was born at Williamsburg, Mass., in 1846.

MR. J. T. MURRAY.—The death is announced at Springfield, Mass., of Mr. Joseph T. Murray, an old electrician, who was Mr. Edison's first business partner. Mr. Murray was born in Salem, May 12, 1834. His father, James Murray, was a reporter in the U. S. Senate at the time of the war of 1812. He learned the machinist's trade. For two years he was postmaster at Danvers. In 1848 he became an abolitionist and participated in many of the stirring incidents of the time. With John Greenleaf Whittier and ex-Mayor Buffum, of Lynn, he formed a link in "the underground railway." He was arrested by U. S. Marshal Devens on the charge of smuggling a negro through to Boston. He served in the 35th Mass. Regiment in the Civil War. In 1870, with George Harrington, who had been secretary of the treasury under Lincoln, he controlled an autmoatic telegraph system. Harrington sold out to Jay Gould, who, it is alleged, tied up both Mr. Murray and the invention. About this time he met Mr. Edison, who was then a struggling telegrapher. The firm of Edison & Murray was formed for the purpose of making telegraph machinery. The firm brought out the system of telegraph printing used in the ticker service of the stock exchanges. At one time Murray had patents estimated to be worth $1,500,000. He made and lost several fortunes.

Personal.

MR. W. D'A. RYAN gave a lecture at Memphis, Tenn., Jan. 10, on the subject of illuminating engineering.

MR. JAMES R. CRAVATH gave a talk on illumination, illustrated with stereopticon, before Engineers' Council 191 of the Royal League at Chicago, January 21.

MR. E. O. McDOWELL will represent the Trenton Porcelain Company and the E. H. Freeman Company, of Trenton, N. J., at the Tribune Building, 154 Nassau Street, New York City.

MR. JOHN E. SEWELL, general manager of the Connecticut Railway & Lighting Company, has resigned from that position. He had been connected with the company for twelve years.

MR. E. M. THOMAS, formerly electrician of the St. Clair Tunnel Company, which owns the Grand Trunk Tunnel at Port Huron, Mich., has recently been made electrical engineer of the Grand Trunk Railroad with headquarters at Montreal. This gives him charge of the electrical work of the motive power department for the entire system.

MR. H. A. NICHOLL, of Anderson, Ind., general manager of the Indiana Union Traction Company, has been elected president of the Central Electric Railway Association. Mr. Nicholl has been connected with the traction company for ten years, gradually working up from one position to another until reaching the high position which he now fills so efficiently and successfully.

MR. G. H. NOBLE.—Among other recent steps taken to meet the rapid extension of their business, W. S. Barstow & Company, of New York, and Portland, Ore., have added to their organization a commercial department, which has been placed in charge of Mr. G. H. Noble. Mr. Noble is well known in electrical circles, having been for six years a salesman in the New York office of the Stanley-G. I. Electric Manufacturing Company.

MR. HENRY H. GEARY, treasurer and manager of the Fostoria Incandescent Lamp Company, was married on Jan. 23 to Miss Fannie H. Leppard at the home of the bride's sister, Mrs. Andrew Emerline, Jr., at Fostoria, Ohio. Mr. L. P. Sawyer acted as best man. Mr. Geary has a large number of friends in the electrical field, all of whom wish him long life and much happiness. After two or three weeks' travel in the South, Mr. and Mrs. Geary will return to Fostoria, where they will reside.

MR. C. W. CHASE, secretary of the Mobile Light & Railway Company, Mobile, Ala., has resigned to accept a position in Leavenworth, Kan. The employes of the different departments on Jan. 16 presented Mr. Chase with a solid silver service, consisting of five pieces in a handsome case. Mr. Z. P. Watson has been elected to succeed Mr. Chase. Mr. C. T. N. White-Spunner, who has been with the Mobile Railway & Light Company in different capacities for several years, has been elected treasurer.

MR. ALBERT W. FOSTER, of Chicago, who represented Westinghouse Electric & Manufacturing Company's interests in Brazil, S. A., for the past four years, is now electrical and mechanical engineer with the Florida and East Coast Hotel Company, commonly known as the H. M. Flagler interest, and including railroad and steamship lines. Mr. Flagler's latest scheme is being realized in the building of an ocean railroad from Miami to Key West, Fla. When finished it promises to be one of the present day feats of railroad building.

MR. SAMUEL L. NAPTHALY, chief engineer of maintenance and operation of the San Francisco Gas & Electric Company and the California Gas & Electric Corporation, has resigned his position with those corporations to accept a position with the Fleischhacker interests of San Francisco. On the first of March Mr. Napthaly will become manager of the Truckee River General Electric Company and the American River Electric Company, both interests being controlled by the Fleischhackers. It is probable, also, that Mr. Napthaly will have the management of the new City Electric Company, recently incorporated in San Francisco.

MR. THEODORE P. SHONTS of the Panama Canal Commission is to become the president of the Interborough-Metropolitan Company, succeeding August Belmont, who is to be chairman of the Board of Directors of both the Interborough-Metropolitan and the Interborough Rapid Transit Company. John B. McDonald has been elected vice-president of the Interborough-Metropolitan. Mr. E. P. Bryan, now vice-president of the Interborough Rapid Transit, is to be its president. Mr. Shonts did not accept the offer until the matter had been taken up with President Roosevelt, who gave his consent to the release of Mr. Shonts from the Panama Canal Commission. Mr. Shonts will not give his entire attention to the duties of his new office until after March 4, on which date he will retire from his present office. The announcement is made that as vice-president Mr. McDonald is to have general supervision of the construction of any new subways built by the company.

DR. CHARLES E. WOLCOTT, director of the Geological Survey, has been elected secretary of the Smithsonian Institution by the Board of Regents at their annual meeting and is now its executive head. Dr. Walcott is a geologist and paleontologist of recognized distinction, and has won for himself a reputation among the scientists, not only of this country, but also of Europe. The degree of L.L. D. has been conferred upon him by Hamilton College, the University of Chicago, and Johns Hopkins University. He has been Director of the Geological Survey since 1894, and Secretary of the Carnegie Institution since 1902. He is a member of the National Academy of Sciences and of the American Association for the Advancement of Science, and is the author of important scientific works. Having served as Assistant Secretary of the Smithsonian Institution, he will enter upon work with which he is thoroughly familiar. The salary of his new position is $7,000 a year, while that of the Director of the Geological Survey is $6,000. Dr. Walcott is nearly 57 years old and long has been a resident of Washington.

HON. R. P. PORTER has written a most interesting volume on "The Dangers of Municipal Ownership," published by the Century Company. His argument is that municipal ownership, or municipal trading, as it is called abroad, is an undesirable element in State and local government, and a menace to progress and to society, that it is financially unsound, and that an examination of specific public undertakings supports the general argument. He outlines the history of municipal ownership in Great Britain, and sets forth what seem to him serious aspects of the municipal position in that country which have arisen consequent upon an indiscriminate pursuit of the system, with suggestions of the probable effect of the extension of a similar method of conducting public utilities in the United States. Mr. Porter is a journalist of thirty years' standing and writer on economic questions. His experience in municipal and financial questions began under Gen. Francis A. Walker in the work of the Tenth Census. He was appointed a member of the Tariff Commission in 1882, and later Director of the Eleventh Census. In 1898 President McKinley made Mr. Porter a special commissioner to Cuba and Porto Rico, and he was active in the preparation of tariff and fiscal laws for those islands.

MR. J. H. HUNTER, the vice-president of the recently organized Detroit Insulated Wire Company, was formerly connected with the National Cable & Wire Company. Mr. Hunter's early technical training was acquired at the Western University of Pennsylvania. While there he gave special attention to electrochemical problems and especially those bearing on the manipulation of organic substances. For seven years

J. H. HUNTER.

A. HARTWELL.

Mr. Hunter was electrical engineer for the Alleghany County Light Company, of Pittsburg. Later he formed a partnership with Professor Koch of the department of chemistry at the Western University of Pennsylvania for the manufacture of certain chemical specialties, in which firm he still retains an interest. He was later engineer of ways for the Pittsburg & Allegheny Telephone Company during the construction and equipment of this plant, and was one of those instrumental in securing its franchise. Following this, he purchased an interest in the National Cable & Wire Company, of which he was elected vice-president. As vice-president of the new Detroit Insulated Wire Company he will have charge of manufacture. Mr. Arthur Hartwell, well known to the electrical trade as formerly sales manager of the Westinghouse Electric & Manufacturing Company, is secretary and treasurer of the Detroit Insulated Wire Company, which has recently erected a factory at Detroit. Mr. Hartwell graduated from Ohio State University in mechanical engineering after which he soon entered the employ of the Westinghouse Electric & Manufacturing Company with which he remained for about 15 years, passing through nearly every department of the factory except the drawing room. He had much to do with the first long distance transmission work for which the Westinghouse Company furnished apparatus in 1890. In 1895 he was made manager of the Pittsburg sales office of the company and in 1899 was transferred to a similar position in charge of the Chicago office. In 1901 he was made head of the sales department of the company. During his administration the sales organization was reorganized into the present divisions of railway and light, detail and supply, and industrial and power, each division having a separate manager as an active assistant to the sales manager. In 1904 he acquired an interest in the Sterling Varnish Company, at Pittsburg, and became its general manager. As a salesman and sales manager he has always held the theory that the jobbers of electrical supplies perform an important, indispensable function for the manufacturer and that they are entitled to a liberal margin of profit and protection, a principle which was difficult to establish in the early days.

News of the Trade.

THE GENERAL ELECTRIC COMPANY has decided to make extensive enlargement of its plant in Fort Wayne, Ind. A new, three-story building will be erected on the corner of Calhoun and Clifton Streets and equipped with new machinery for making incandescent lamps.

OIL ENGINES.—The commission appointed by the French Government to look into petroleum engines for the French navy, has completed its tests on various engines and has recommended the Mietz & Weiss system, and purchased the 22 hp of marine oil engine of this make which was under test.

CRANE COMPANY, Chicago, now has its new steel foundry in full running order. In this department steel valves and fittings will be a specialty, and the facilities are such that promptness in the filling of orders for these goods is assured. This addition to the company's varied activities is simply another proof of its efforts to keep abreast—if not, indeed, a little ahead—of the times.

NEW WESCO FACTORY.—The announcement of the new factory building of the Wesco Supply Company, St. Louis and Ft. Worth, Tex., exemplifies the enterprise which has characterized this electrical supply house ever since its inception. Among the articles of recognized merit manufactured especially for this company are the Wesco desk and ceiling fans, tape, soldering specialties, the Red Shield and Wesco dry batteries and Hercules pliers. A few years ago, the company began assembling its own telephones in order to insure perfect uniformity, and has since added the latest machinery tools and dies for the manufacture of parts until within the last year, it has been manufacturing practically complete instruments in its own factory. The strict adherence to the policy of quality in the production of Wesco telephones has resulted in such rapid growth in the demand for its product that it has become necessary to provide larger quarters and better facilities to meet this demand. A large five-story brick building at the corner of 8th Street and Clark Avenue, St. Louis, was therefore recently secured and has been equipped throughout with the latest machinery for the manufacture of a complete line of telephone instruments and accessories. In addition, a portion of the factory is being equipped for the manufacture of knife switches, panel boards, cut-out cabinets and switchboards.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, S. S. Sadtler, 59 S. 10th St., Philadelphia.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty St., New York. Meetings, fourth Friday of each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, Calvin W. Rice, 12 West 31st St., New York. Spring meeting, Indianapolis, Ind., May, 1907.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Municipal Building, Brooklyn, N. Y. Next meeting Detroit, Mich., third Wednesday, September, 1907.

AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION. Secretary, B. V. Swenson, 60 Wall St., New York.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, George R. Stetson, New Bedford, Mass.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND. Secretary, Welles E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Atlantic City, N. J., June 19, 1907.

CALIFORNIA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, P. T. Whittier, Spencer, Cal.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, T. S. Young, Toronto, Ont.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, John F. Dostal, 405 17th St., Denver, Col. Next meeting, September, 1907.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn.

ELECTRIC CLUB OF CLEVELAND. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

ELECTRICAL CONTRACTORS' ASSOCIATION OF STATE OF MISSOURI. Secretary, Chas. J. Sutter, 1220 Pine St., St. Louis, Mo.

ELECTRICAL SALESMEN'S ASSOCIATION. Secretary-Treasurer, Geo. H. Erich, 401 Monadnock Block, Chicago. Next annual meeting, Chicago, January, 1907.

ELECTRICAL TRADES ASSOCIATION OF CANADA. Secretary, Wm. R. Stavely, Royal Insurance Building, Montreal, Can. Next annual meeting, Montreal, January 14, 1907.

ELECTRICAL TRADES ASSOCIATION OF CHICAGO. Secretary, Frederic P. Vose, Marquette Building, Chicago.

ELECTRICAL TRADES ASSOCIATION OF PHILADELPHIA. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays each month.

ELECTRICAL TRADES ASSOCIATION OF THE PACIFIC COAST. Secretary, Albert H. Elliot, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

ELECTRICAL TRADES SOCIETY OF NEW YORK (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall Street, New York. Board of Directors meets second Friday of each month.

EMPIRE STATE GAS AND ELECTRICAL ASSOCIATION. Secretary, R. A. Davidson, 58 William St., New York. Next meeting, November, 1907.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

ILLINOIS STATE ELECTRICAL ASSOCIATION. Secretary, H. E. Chubbuck, La Salle, Ill.

ILLUMINATING ENGINEERING SOCIETY. Secretary, Dr. Arthur H. Elliot, 4 Irving Place, New York. Meetings in New York, second Friday of each month.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Landgrebe, Huntingburg, Ind.

INDIANA ELECTRIC RAILWAY ASSOCIATION. Secretary, P. H. White, Indianapolis, Ind. Monthly meetings, second Tuesday of each month.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Norfolk, Va.

IOWA ELECTRICAL ASSOCIATION. Secretary, L. B. Spinney, Iowa State College, Ames, Ia. Next meeting, Clinton, Ia., April, 1907.

IOWA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Boone, Ia. Next meeting, Sioux City, Ia., March 12-14, 1907.

IOWA STREET AND INTERURBAN ASSOCIATION. Secretary, L. D. Mathes, Dubuque, Ia. Next meeting, Clinton, Ia., May, 1907.

KANSAS GAS, WATER & ELECTRIC LIGHT ASSOCIATION. Secretary, James D. Nicholson, Newton, Kan. Next meeting, Topeka, Kan., October 16, 1907.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ky. Regular meeting, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRIC ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Houck McHenry, Jefferson City, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. C. L. Eglin, Philadelphia, Pa.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee Street, Utica, N. Y. Next meeting, New York City, July 17, 18 and 19, 1907.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next annual meeting, Chicago, second Thursday in June, 1907.

NATIONAL-INTERSTATE TELEPHONE ASSOCIATION. Secretary, A. L. Tetu, Nashville, Tenn.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y. Next meeting, Syracuse, N. Y., June, 1907.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1908.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, O. Next meeting, Toledo, Aug. 20-22, 1907.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Portsmouth, O. Next meeting, Columbus, O., last Thursday in April, 1907.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, O.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, O.

OLD TIME TELEGRAPHERS AND HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls, N. Y., 1907.

PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION. Secretary, Samuel G. Reed, Portland, Ore.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second Street, Philadelphia, Pa.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Secretary, Charles H. Smith, Lebanon, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meetings second Saturday of each month.

PUBLIC UTILITIES ASSOCIATION OF INDIANA. Secretary, J. A. Shunk, Peru, Ind. Regular meetings second Thursday in May and December.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby Street, Boston, Mass. Next meeting, March, 1907.

VERMONT AND NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Buzzell, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vermont.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Wednesday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1, each year.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 22, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N.Y.]

841,709. ELECTRIC BRAKE; Frank C. Newell, Wilkinsburg, Pa. App. filed May 3, 1900. Details of construction of a running controller having a single shaft with a switch and resistance controlling device thereon, and means whereby the switch and controlling devices may be moved together, or the resistance device may be moved independently of the switch, by rotation of the shaft.

841,719. ELECTRIC BRAKE; Frank C. Newell, Wilkinsburg, and Edward H. Dewson, Edgewood Park, Pa. App. filed Apr. 11, 1904. Relates to modifications of the above. The motors are adapted to be connected up as generators in a local brake circuit. Provides a breaking controller and circuit connections whereby the current in the brake circuit may be controlled.

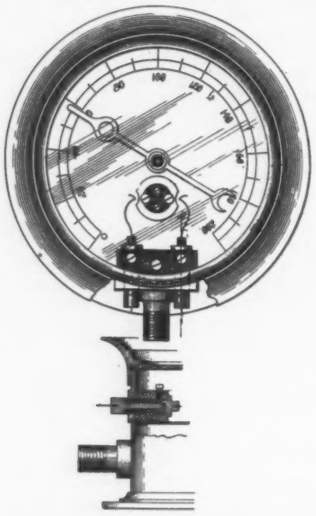
841,720. ELECTROLYTIC APPARATUS; John H. Ryan, Portland, Oreg. App. filed Mar. 1, 1906. An electrolytic apparatus comprising a trough adapted for conveying a stream of electrolyte, electrodes therein connected electrically in multiple, and means operating simultaneously on a plurality of said electrodes to adjust their positions, substantially as described.

841,724. PRODUCTION OF ALKALI METALS; George O. Seward and Franz Von Kugelgen, Holcombs Rock, Va. App. filed Apr. 23, 1906. The production of an alkali metal by the electrolysis of the chloride of the alkali metal sought, with the addition of fluoride of the same metal and chloride of an earth-alkali metal.

841,743. ALARM GAGE; George A. Wall, Providence, R. I., and John H. Derby, Brookline, Mass. App. filed Feb. 17, 1904. The usual gear of a pressure gage which meshes with the pinion carrying the usual pointer, has a cam thereon which makes contact with a spring to close an alarm circuit.

841,747. TELEPHONE TRUNKING CIRCUITS; Harry G. Webster, Chicago, Ill. App. filed July 3, 1902. Details of circuits for a trunking exchange including the usual signaling and busy test circuits.

841,765. ILLUMINATING APPARATUS; Norman D. Bishop, Los Angeles, Cal. App. filed Aug. 24, 1904. A tubular frame contains longitudinal bars which may be made the circuit connections of a



841,743.—Alarm Gage.

plurality of incandescent lamps within the frame. An air circulation is provided to keep the apparatus cool.

841,767. SIGNAL; Edward J. Condon, Dixon, Ill. App. filed Nov. 13, 1905. A mechanical tappet alongside the track is impelled by a passing car to compress air in a piston, and this air actuates the semaphore signal to danger. The semaphore is released by an electrical trip.

841,769. TELEPHONE TRUNKING SYSTEM; William W. Dean, Chicago, Ill. App. filed Feb. 6, 1903. In a telephone trunking system, the combination with a testing outfit at the incoming end, a relay to control the connection of said outfit with said end of the trunk, means to control said relay from the outgoing end of the trunk and from the called-subscriber's line, and means to initially energize said relay in calling the wanted subscriber, substantially as described.

841,820. ELECTRIC ARC LAMP; Braxton L. Scott, Washington, D. C. App. filed Sept. 6, 1905. Details of construction of an arc lamp having depending magnet operative plungers which engage mechanical clutches acting on the carbon.

841,844. KEY OPERATED LOCKING SWITCH; John Bernet, Chicago, Ill. App. filed Feb. 10, 1905. An ordinary Yale combination lock has a switch arm connected thereto so that the latter cannot be turned except by the insertion of an appropriate key in the lock.

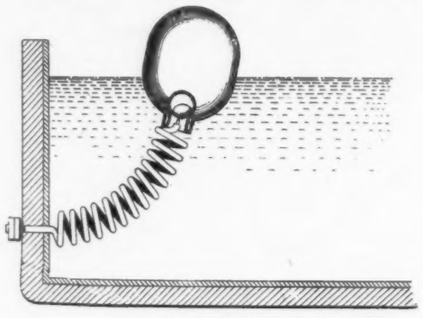
841,849. ELECTROTHERMAL PROTECTOR; Frank B. Cook, Chicago, Ill. App. filed Apr. 16, 1906. A thermal element consists of a piece of graphite which is electroplated at the ends so as to be capable of being soldered to spring blades connected in the circuit to be broken.

841,855. ELECTRIC SIGNAL; William F. Dreer, Coulters, Pa. App. filed Oct. 27, 1906. A mechanical arm or bearer is displaced by the wheel flange so as to move a switch arm into a position to close a red light circuit.

841,870. HOISTING APPARATUS; Charles W. Hunt, New York, N. Y. App. filed July 24, 1906. Diagram of circuits for motor-driven hoists in which the motor may be slowed down and stopped and the brake applied and the motor also reversed by movement of a single controller arm.

841,874 ROTARY CURRENT-MOTORS CONNECTED IN CASCADE SYSTEM; Coloman de Kando, Budapest, Austria-Hungary. App. filed Oct. 14, 1903. In a system of electric traction a plurality of rotary current-motors with their rotors on the same driving axle, and a single set of collector-rings located outside the motors, to which rings the windings of both motors are connected, and connections leading through one of the motors to said collector-rings.

841,914. CABLE-HOLDING CLIP; Augustus Andrews, Gulfport, Miss. App. filed Nov. 3, 1906. A clamping-plate designed to embrace a cable and bent to form a shell, lugs projecting from one end of the



842,082.—Circuit Closer.

plate and adapted to engage over the ends of the flattened portions of the plate, and means for holding said lugs in locking relation.

841,975. ELECTRICALLY OPERATED HAMMER; Ronald P. Irving, Quincy, Mass. App. filed May 21, 1906. A toy hammer having a magnet coil with a plunger therein which impels a switch lever into circuit opening relation at the conclusion of its forward movement.

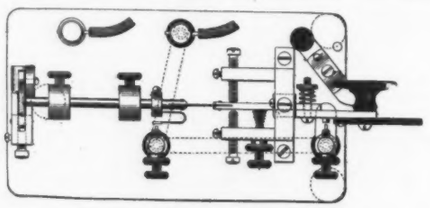
841,993. TELEPHONE SWITCH-HOOK; Ray H. Manson, Elyria, O. App. filed Dec. 2, 1905. A telephone switch-hook stamped from a single integral sheet of metal and having prongs and a shank, said prongs and shank being folded along their length to make the device of double thickness, and a pivoted connection at the end.

842,020. RECEPTACLE FOR INCANDESCENT ELECTRIC LAMPS; Bert E. Salisbury, Syracuse, N. Y. App. filed Aug. 16, 1905. A porcelain receptacle adapted to be assembled on a sheet-iron support for electric signs, etc. The metallic clips for the terminals are inserted from the back and are afterwards covered up by insulating cement after the circuit wires are in place.

842,082. CIRCUIT-CLOSER; Ernest S. Clayton, Newark, N. J. App. filed. Dec. 16, 1905. A high-water alarm consisting of a float supported by a spiral spring. In case of high water the float moves into such a position that a metallic ball closes the circuit between two contact points.

842,099. ELECTRIC MELTING OR REDUCING FURNACE; Gilbert C. Landis, Carlisle, Pa. App. filed Sept. 21, 1904. An electric furnace having a carbon lining comprising inner and outer portions, the inner portions having a plugged tapping-opening and the outer portion having a projecting tapping-spout, substantially as described.

842,110. MULTIPLE CIRCUIT PANEL; Henry T. Paiste, Philadelphia, Pa. App. filed Apr. 12, 1906. Has a plurality of sections of insulating material and a plurality of metallic connections with fuse



842,154.—Telegraph Transmitter.

plug sockets, each socket having one terminal engaging one of said metallic connections and a second terminal for the attachment of a conductor.

842,123. CONTAINING-CELL FOR BATTERIES; George H. Stout, Chicago, Ill. App. filed Aug. 13, 1903. A cell comprising a casing or cell proper, having a series of slots or grooves on opposite sides, a series of elements received in said slots to form one electrode, and a plate arranged in the bottom of the cell to form the other electrode.

842,134. SPACE TELEGRAPHY; Sewall Cabot, Brookline, Mass. App. filed Nov. 25, 1905. In a space-telegraph system, a transmitting system, a receiving system, an elevated conductor, a sending-key, a high-potential switch constructed and arranged to alternately connect said elevated conductor to said transmitting and receiving systems, said switch comprising means for augmenting the gap in the circuit beyond an air-gap formed between two contacts, and means controlled by said sending-key for operating said switch.

842,154. TELEGRAPH-TRANSMITTER; Horace G. Martin, New York, N. Y. App. filed Apr. 16, 1906. Relates to details of a telegraph key in which dots are continuously produced as long as the key is in one position, and dashes as long as it is in the alternate position of its throw.